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An illustrated identification key to the acalyptrate fly families (Diptera: Schizophora) occurring in southern Africa

by

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ABSTRACT

An illustrated identification key is presented to the 47 families (including one undescribed) in 11 superfamilies of acalyptrate Diptera, known to occur in southern Africa. Apterous and brachypterous species are largely excluded, although *Braula* Nitzsch (Braulidae) and *Scutelliseta* Richards (Sphaeroceridae) are identifiable by reference to the figures provided. Wherever possible, supplementary biological and diagnostic information is given in square parentheses at the end of each family exit, to help confirm identifications. The identification of Acalyptratae in southern Africa is discussed, and key characters defining the grouping are listed and illustrated. An alphabetical check-list of included superfamilies and families is given, with information about recent family additions to the regional fauna. A detailed, illustrated glossary is presented of key characters and other terms used in the text and the key.

INTRODUCTION

Diptera are one of the major southern African insect orders, and include families of significant agricultural, medical and veterinary importance. Although commonly regarded as only deleterious, Diptera are also beneficial in numerous respects, and include important plant pollinators and parasitoids of insect pests. At least six southern African parasitoid families of Diptera have potential in the biological control of insect pest species. Although Diptera studies (mainly taxonomic) have been undertaken at the Natal Museum and a large collection of flies assembled there since 1953 (Barraclough & Whittington 1994), no reliable identification keys to the families occurring in southern Africa have been published. Barraclough & Londt (1985) published a key in a student textbook, but this was largely superficial, the key not being original and being based on those produced for other regional faunas. The current work is the first in a series of papers intended to rectify this situation, and to enable southern African biologists to identify Diptera families with some confidence. Although an entomological background is assumed, the illustrations and glossary of key terms supplied below should enable any biologist to use the key.

The acalyptrates are the largest grouping of families within the Diptera. They have, with some exceptions, been notoriously difficult to identify in southern Africa, even by specialist entomologists. This has been emerging as a significant problem in recent times, particularly with rising interest in conservation and biodiversity issues. Southern Africa has a rich acalyptrate fauna, which includes some 47 out of the total of 102 Afrotropical families (Barraclough 1994*a*, Barraclough & Whittington 1994). Included in the key (although presently under description) is a new Afrotropical family centred on southern Africa; it is referred to as 'New Family'.

This is the first original key to the southern African acalyptrate families, and I have attempted to use unambiguous characters wherever possible. It is hoped that these will assist inexperienced users of identification keys, particularly scholars with little knowledge of acalyptrate identification. The development of the subcostal vein and the presence or absence of humeral and subcostal breaks in the costa, have been critically important characters in existing regional keys to acalyptrate Diptera (see e.g. J. F. McAlpine 1981*b*, Barraclough & Londt 1985, Colless & McAlpine 1991). Although these characters are important in acalyptrate classification, I have long considered them to be problematic in identification keys, mainly because they are frequently difficult to assess in certain taxa. This opinion is shared by almost all of my colleagues in South Africa. Consequently I have striven, wherever possible, to use other characters in the following key, although it has certainly not been possible to omit subcostal and costal characters altogether.

Prior to construction of the key, I identified the presence or absence of vibrissae as an important and readily discernible character, usually not open to misinterpretation. I have therefore used this as the sole character in the first couplet, even though the key is significantly lengthened as a result. This is because vibrissae are sometimes pale and/or very small in some taxa and variably developed (i.e. both present and absent) in nine families (Chloropidae, Ephydridae, Canacidae, Chyromyidae, Sepsidae, Neurochaetidae, Milichiidae, Neminidae, Aulacigastridae). As a result, these families exit in at least two places in the key. I have considered it more appropriate to construct the key in this way, rather than attempt to modify a key based on costal breaks and the development of the subcosta, the interpretation of which is unpredictable.

Before any attempt is made to use the key, I strongly recommend that the illustrated glossary of key characters and other terms be read in conjunction with the introductory figures of a hypothetical acalyptrate fly. Although the key is based on southern African acalyptrate material, it should work reasonably well for acalyptrate taxa collected in other parts of subsaharan Africa. The Mormotomyiidae, based on a unique spider-like and apterous species from Kenya, is the only African acalyptrate family not covered by the key. The only known species is associated with bats and caves. The family was recently transferred to the Acalyptratae by J. F. McAlpine (1989). Reference should be made to Austen (1936) and Emden (1950).

MATERIALS AND METHODS

Data were scored for an initial 32 characters, although some of these were subsequently abandoned and others selected. The key is based predominantly on the acalyptrate collection at the Natal Museum. This is the largest and most representative collection of Diptera in Africa, and includes every acalyptrate family recorded from southern Africa (see Barraclough & Whittington 1994). During March 1994, I visited the Diptera Section at The Natural History Museum (London), and tested the final draft of my key against southern African acalyptrate taxa not present in the Natal Museum's collection. With a few exceptions, the final key has been tested against every acalyptrate genus recorded from southern Africa, and in each case as broad a representation of species as possible.

Southern Africa was treated as the subregion south of the Zambezi river in the east and south of 17°30'S in the west. Included countries are South Africa, Lesotho, Swaziland, (southern) Mozambique, Zimbabwe, Botswana and Namibia.

It should be emphasised that the terms used in the following key are not necessarily consistent with the most recent literature. They have been selected for ease of use and recall, based on my personal experience in working with acalyptrate keys. In most cases I have given preference to simple descriptive terminology. Good examples are the terms used for wing crossveins, in preference for example to those used by J. F. McAlpine 1981*a* (given in parentheses): apical crossvein (crossvein dm-cu), anterior crossvein (crossvein r-m) and basal crossvein (crossvein bm-cu). Wherever possible, abbreviations have not been used in the key, so as to facilitate its use.

The terms bristle (= seta), setula, spine and spur are defined and/or referred to in the glossary (see below). Some of these definitions are somewhat arbitrary; note that the spines and spurs referred to in the text do not necessarily lack alveoli (see Miller 1977). A common difficulty with the identification of acalyptrates is the loss of bristles in certain specimens, particularly on the head. The presence of such bristles can still, however, be determined by looking for the bristle's socket on the cuticle.

Illustrations were drawn using a Wild M5 stereomicroscope and camera-lucida. Most drawings of the head are in an oblique anterior view, although a few are anterior, profile or dorsal views. The proboscis and palpi are usually omitted (Conopidae, Milichiidae (part) and Sphaeroceridae excepted).

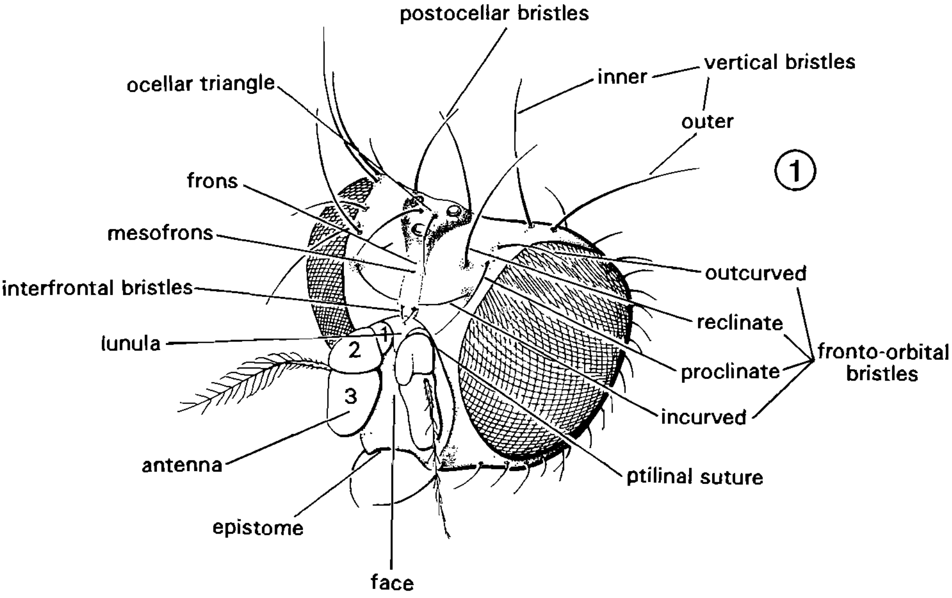
RECOGNITION OF ACALYPTRATE DIPTERA

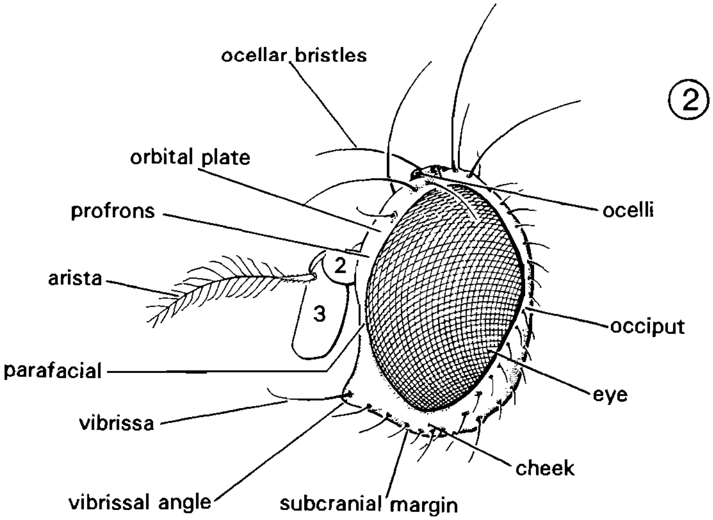
In recent major works on Diptera there have been different interpretations of higher classification, and acalyptrates have been treated either in the suborder Brachycera or Cyclorrhapha. I here concur with Colless & McAlpine (1991), who treat the Acalyptratae within the suborder Brachycera, Division Cyclorrhapha and series Schizophora.

Although the acalyptrates are now recognised as a monophyletic subgroup of Schizophora (J. F. McAlpine 1989), the subgroup is difficult to define using a consistent set of character states, as there are always exceptions given the large number of constituent families. It has long been recognised that the size of the lower calypter is too variable to define the acalyptrates as such, and other defining character states have been added. These need to be considered in combination when assessing whether a particular specimen is an acalyptrate:

1. Antenna short, with three major segments (Fig. 1); third segment not subdivided and typically enlarged with bristle-like arista, this usually dorso-basally positioned (Fig. 1) (arista absent in Cryptochetidae).
2. Second antennal segment usually without dorsal longitudinal seam or this incomplete.
3. Ptilinal suture or fissure usually present above antennal bases, continuing ventrally along margins of face as an inverted 'U' (Fig. 1). In cases where the complete ptilinal suture is difficult to see, flies possessing it can be recognised by the presence of the lunula (Fig. 1) above the bases of the antenna.
4. Maxillary palp (of proboscis) usually with only one discernible segment (Fig. 34) (palpi short or vestigial in Sepsidae).

5. Lower calypter usually small and inconspicuous (Fig. 11), sometimes barely visible.
6. Mesonotum without complete transverse suture anterior to wing bases, i.e. suture not crossing over, incomplete medially (Figs 10 & 11).





Figs 1–2. Structure and terminology of an acalyptrate head (proboscis, palpi and insignificant vestiture omitted). 1. Anterolateral view. 2. Lateral view.

With routine identification of Diptera, it soon becomes relatively easy to recognise an acalyptrate, even those taxa with atypical character states, such as many

Platystomatidae with enlarged lower calypters. *Sepedon* species (Sciomyzidae) have no apparent ptilinal suture, although their other character states are typical of acalyptrates. For additional details, reference should be made to Colless & McAlpine (1991) and J. F. McAlpine (1981*a*,*b*).

CHECKLIST OF SOUTHERN AFRICAN ACALYPTRATE FAMILIES

Table 1 is an alphabetical list of the superfamilies, and their included named families, treated in the following key. These concur largely with Colless & McAlpine (1991). The most recent catalogue of Afrotropical Diptera (Crosskey 1980) records 38 *named* families from southern Africa; this is 8 families fewer than the current total of 46. Additional family records from southern Africa are: (1) Anthomyzidae (Roháček 1993); (2) Aulacigastridae *s. s.* (Barraclough 1993, Duxbury & Barraclough 1994), note that the Aulacigastridae of Sabrosky (1980) are now treated as Periscelididae; (3) Carnidae (Barraclough 1994*b*); (4) Campichoetidae (Barraclough 1992, Duxbury & Barraclough 1994); (5) Chyromyidae (unpublished data). Aulacigastridae *s. s.* and Campichoetidae are also new family records for the Afrotropical Region. New families described or elevated from subfamily status, since the catalogue of Crosskey (1980), are: (1) Ctenostylidae [previously treated as the Lochmostyliinae, a subfamily of Pyrgotidae (see Steyskal 1980), but here given

TABLE 1

Alphabetical list of 11 superfamilies and 47 families of acalyptrate Diptera (Schizophora) occurring in southern Africa. [New family records or status since the Afrotropical Diptera Catalogue of Crosskey (1980) are indicated as **n. rec.** and **n. stat.** respectively.]

Asteioidea

Anthomyzidae, **n. rec.**
Asteiidae
Aulacigastridae, **n. rec.**
Neminidae, **n. rec, n. stat.**
Neurochaetidae
Periscelididae

Brauloidea

Braulidae

Chloropoidea

Canacidae
Carnidae, **n. rec.**
Chloropidae
Milichiidae
Tethinidae

Conopoidea

Conopidae

Diopsoidea

Diopsidae
Psilidae

Ephydroidea

Camillidae
Campichoetidae, **n. rec.**
Cryptochetidae
Curtonotidae
Diastatidae
Drosophilidae
Ephydridae

Heleomyzoidea

Chyromyidae, **n. rec.**
Heleomyzidae
Sphaeroceridae

Nerioidea

Micropezidae
Neriidae

Opomyzoidea

Agromyzidae
Clusiidae
Marginidae, **n. rec.**
Odiniidae
Opomyzidae

Sciomyzoidea

Celyphidae
Chamaemyiidae
Coelopidae
Lauxaniidae
New Family
Sciomyzidae
Sepsidae

Tephritoidea

Ctenostylidae, **n. stat.**
Lonchaeidae
Otitidae
Piophilidae
Platystomatidae
Pyrgotidae
Tachiniscidae
Tephritidae

family status (see Barraclough 1994a)]; (2) Marginidae (D. K. McAlpine 1991); (3) Neminidae (Freidberg 1994). The Afrotropics is the only region from which Pseudopomyzidae (Nerioidea) have not been recorded, and I believe it likely that the family will eventually be discovered in montane parts of Africa, and probably in the Drakensberg. Pseudopomyzidae have not been included in the family key, but reference should be made to D. K. McAlpine (1994).

GLOSSARY OF KEY CHARACTERS AND MORPHOLOGICAL TERMS

Anal cell. This cell is positioned in the posterobasal section of the wing, just posterior to the second basal cell (Fig. 9). If the anal crossvein is absent the anal cell is referred to as open (Fig. 48), if present the cell is closed. Note that the anal cell is always open in certain families, namely Chloropidae, Ephydridae, Camillidae and Periscelididae; in some species of these families it is absent or virtually so (Fig. 50). The anal cell always has a variously developed, acute posterodistal projection in Tachiniscidae, sometimes so in Pyrgotidae, often so in Tephritidae (Fig. 57) and usually so in Otitidae (Fig. 58) and Conopidae (Fig. 59).

Anal lobe. The posterobasal section of the wing, posterior to the anal cell (Fig. 9).

Aristal vestiture. The arista may lack vestiture, in which case it is bare. Short, often barely visible vestiture is referred to as pubescence (e.g. Figs 31 & 46), whereas longer vestiture (sometimes longer than the width of the third antennal segment) is termed plumosity (e.g. Figs 21, 25 & 36). In Ephydridae, if aristal vestiture is present, it occurs only along the dorsal surface (Fig. 23).

Basal crossvein. This crossvein encloses the second basal cell apically, and is usually slightly distad of the anal crossvein (Fig. 9). When the basal crossvein is absent, the second basal and discal cells are referred to as being confluent (e.g. Figs 48–50).

Bristle (= seta). A stiff, usually dark, hair-like projection on the head, thorax, legs and abdomen. The position of bristles on the legs, particularly the tibiae, is determined by imagining the entire leg as stretched outwards and about perpendicular to the thoracic pleuron. Bristles on the upper and lower surfaces, for example, are then termed dorsal and ventral respectively.

Calypters. The posterobasal section of the wing is differentiated into two flap-like membranous lobes, which are folded one above another; these are termed the upper and lower (Fig. 11) calypters. Both calypters are typically small in acalyptrates, the upper calypter often being barely discernible. The margins of both calypters are usually fringed with hairs; the margin of the lower calypter is attached to the thoracic pleuron.

Cheek. Refers (in this work) to the region between the lower margin of the eye and the subcranial margin, bounded anteriorly by the vibrissal angle and posteriorly by the occiput (Fig. 2).

Costal breaks. The costa is the first vein, which runs along the anterior margin (= leading edge) of the wing, usually terminating near the wing apex (Fig. 9). Breaks can be noted by gaps in the costal vein itself or areas where there is a lack of costal setulae running along the costal vein on the anterior margin of the wing. Breaks in the costa may appear as inconspicuous 'fissures' or obvious interruptions. The recognition of these features is often vital in identifying acalyptrate families and great care needs to be taken when examining the wing. In doubtful cases it is often advisable to examine more than one specimen of a particular species, as unusual flexure or folding of the wing can obscure the breaks. Occasionally, the break is more evident when the wing is viewed ventrally. The wing should always be viewed backlit against a horizontal white surface (paired, fibre-optic, swan-neck light source tubes are most appropriate).

Two breaks need to be recognised for the purposes of this key. The first is termed the humeral break and may be evident just beyond the humeral crossvein (Fig. 9). The subcostal break is often more obvious and is positioned near the apical insertion of the subcostal vein (Fig. 9). Spine(s) and more conspicuous setula(e) are sometimes differentiated on the costa just basad of the subcostal break (e.g. Figs 9 & 56).

Epistome. The lower margin of the face (often projecting) between the vibrissae/vibrissal angles (Fig. 1).

Facial carina. A median, vertical ridge on the face, positioned between the antennae (Fig. 37). If strongly developed the carina separates the antennae.

Fascia. A transverse band, often used to describe the distribution of pollinosity, or the nature of wing patterning.

Frons. This is defined as the upper part of the head between the eyes, bounded anteriorly by the lunula and antennal bases and posteriorly by the upper margin of the occiput and often the ocellar triangle (Fig. 1). The profrons is that part of the frons just posterior to the antennae and above the upper extent of the parafacial (Fig. 2).

Fronto-orbital bristle(s). These bristles are inserted on the orbital plates or parafrontals of the frons (these positioned lateral to the mesofrons and adjacent to the eye margin on each side). The number and particularly the orientation of these bristles is of great importance in recognising acalyptrate families. Note that lower fronto-orbitals are positioned closer to the lunula and antennal bases, and the upper fronto-orbitals closer to the ocellar triangle. I have selected four terms to describe the orientation of bristles. These are: outcurved (directed outwards above the upper eye margins); incurved (inwardly directed towards the mesofrons); proclinate (anteriorly directed); reclinate (posteriorly directed) (see Figs 1 & 2). These terms are not absolutely restrictive, and are used to describe the predominant orientation of a particular bristle. In other words if a bristle is proclinate with a slight incurved orientation, it is still described as proclinate. When two or more fronto-orbitals are present, different bristles may have different orientations.

Geniculate proboscis. The major shaft or prementum of the proboscis is usually unmodified and relatively straight. In some families, notably Milichiidae (Fig. 34) and Conopidae, the prementum is often markedly bent or elbowed distally.

Interfrontal bristles. These are inserted on the mesofrons between the orbital plates (Fig. 1). Such bristles are usually absent in acalyptrates, but often present in certain families (e.g. Carnidae (Fig. 29), Milichiidae (Fig. 35), Canacidae (Fig. 40) and Coelopidae (Fig. 42)).

Lunula. A small, crescent-shaped sclerite positioned between the dorsal margin of the ptilinal suture and the antennal bases (Fig. 1).

Mesofrons. This refers to that part of the frons between the orbital plates on each side (Fig. 1). It is also referred to as the interfrontal area.

Mid tibial ventral spur. The spur is a spine-like process which is inserted on the apicoventral part of the mid tibia (Fig. 17).

Parafacial. The narrow, strip-like region situated between the face (medially) and the anterior eye margin (laterally) and limited by the profrons above and the vibrissal angle region below (Figs 1 & 2).

Pollinosity. Opaque surface covering resembling fine powder or dust.

Porrect antennae. Such antennae are prominent and forwardly directed in profile (e.g. Figs 30 & 44).

Postocellar bristles. The terms postocellar and postvertical have been used for small paired bristles or setulae inserted from between just behind the ocellar triangle to the upper occipital region (see Fig. 1). These include pseudo-postocellar bristles (modified ocellar setulae), such as occur in Ephydridae (see Wirth *et al.* 1987), which are inserted just behind the posterior ocelli. In this work, to avoid confusion, only the term postocellar is used. If more than one pair of bristles is present, the postocellars are taken to be the larger pair. As with the fronto-orbital bristles, the orientation of the postocellar bristles is important; if present they are referred to as being convergent (e.g. Fig. 37), cruciate or crossed apically (e.g. Fig. 25), divergent (e.g. Fig. 33) or parallel (e.g. Fig. 29). Care needs to be taken when examining specimens for postocellar bristles as they are sometimes reduced, such as in Anthomyzidae, Asteiidae, Chyromyidae and Lonchaeidae (note that the term setulae is *not* used in such cases). Paravertical bristles (see Steyskal 1976) are sometimes confused with postverticals/postocellars, although they are generally situated (on each side) between the inner postvertical bristle and the postocellars (see e.g. Carnidae (Fig. 29) and Sphaeroceridae (Fig. 30)).

Preapical tibial bristle. A single dorso-apical bristle or setula (Fig. 17); *not* necessarily present on all tibiae.

Presutural bristle. A landmark bristle positioned anterior to the transverse suture, between the notopleural bristles and the presutural dorsocentral bristle (if present).

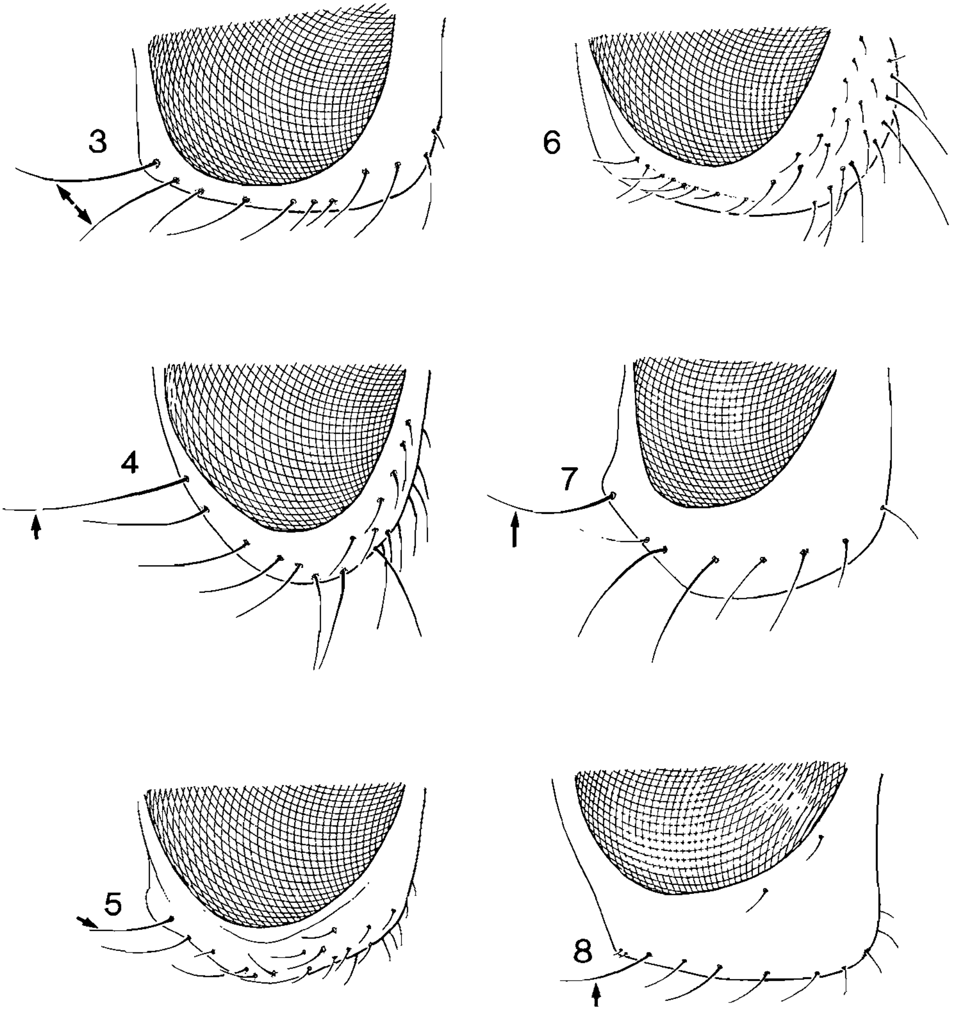
Prosternum. A small sclerite positioned ventrally between the fore coxae, and often surrounded by membrane.

Ptilinal suture. An arcuate slit (inverted 'U') delimiting the facial region below and with its upper margin just dorsad of the lunula and antennal bases (Fig. 1).

Setula. A small bristle; often present on wing veins (e.g. Fig. 57), although also present on numerous other structures.

Strength. This term mainly refers to the development and/or thickness of vibrissae, bristles and setulae.

Subcosta. This wing vein is positioned anterobasally, just posterior to the costa and anterior to vein R_1 (Fig. 9), with which it is often closely associated. Its development



Figs 3–8. Epistomal/vibrissal angle region and cheek of acalyptrate heads in lateral view, showing variable development of typical vibrissae (3–5) and their absence (6–8) in profile (see glossary). 3. **Camillidae** (*Afrocamilla stuckenbergi* Barraclough), showing two vibrissae (arrowed). 4. **Milichiidae** (*Milichia* sp.), showing vibrissa (arrowed) to be longer and stronger than other bristles on anterior part of cheek. 5. **Agromyzidae** (*Melanagromyza metallica* (Thomson)), showing very small vibrissa (arrowed). 6. **Lauxaniidae** (*Homoneura cuthbertsoni* Curran), showing no vibrissa(e) differentiated at or near vibrissal angle. 7. **Periscelididae** (*Stenomicra trimaculata* Sabrosky), showing lack of true vibrissa, but development of pseudovibrissa (arrowed) below vibrissal angle. 8. **Chamaemyiidae** (*Melanochthiphila* sp.), showing anterior cheek/subcranial bristle (arrowed) unusually vibrissa-like.

(particularly apically), its association with R_1, and if it meets the costa separately from R_1, are of great importance in acalyptrate classification. As with costal breaks, it is critical to view the subcostal region backlit over a white surface. Important character states are whether the subcosta is complete to the costal margin, if it is evanescent (undeveloped) apically, or if it is separate from R_1. When the subcosta is complete to the margin as in Curtonotidae (Fig. 56), this means that it does not merge with R_1 as may occur in Ephydridae (Fig. 49) and is not apically evanescent as in Drosophilidae (Fig. 55). The subcosta is sometimes barely visible, as may occur in Chloropidae (Fig. 48). In a few families it is highly modified and is instantly recognisable. In many Tephritidae the subcosta is apically modified, such that it is directed sharply (almost at right angles) towards the costa (Fig. 57). In Psilidae the apex of the subcosta is severed by a transverse hyaline strip in the wing membrane (Fig. 61).

Subcostal spine(s). This term is used in this work to describe the spine, bristle or setula (sometimes two), present on the costa just basad of the subcostal break (Fig. 9). The spine is often stronger and larger than others along the costa (Figs 56 & 57), although if it is of comparable size (as in some Heleomyzidae) it is still considered to be a subcostal spine. Care should be taken when viewing the wing for the costal spine, as the spines are sometimes decumbent, and difficult to distinguish from adjacent vestiture. In cases of doubt it may be necessary to view the costa along its leading edge.

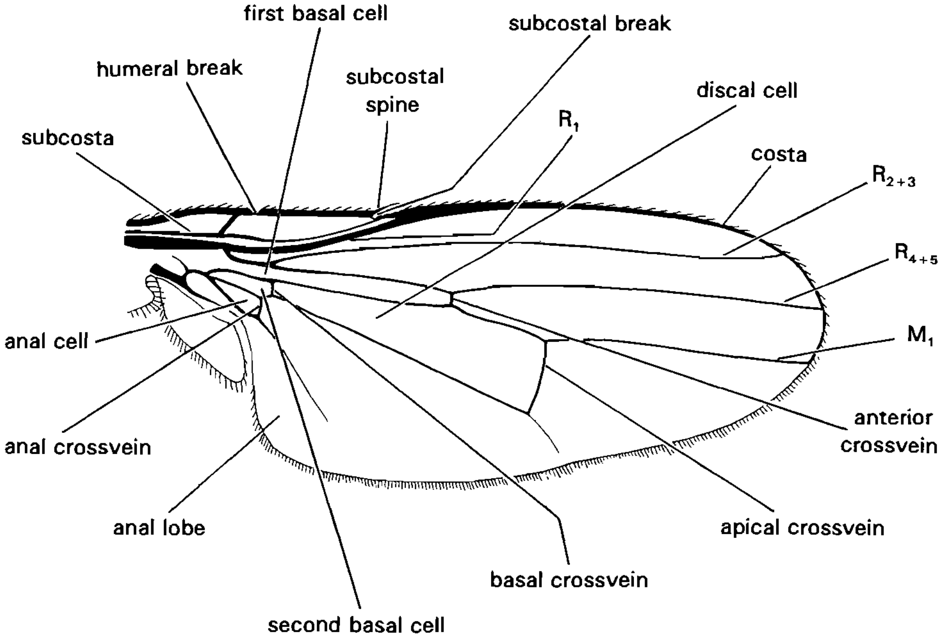


Fig. 9. Terminology of the acalyptrate wing, showing venation and vestiture.

Vibrissa. The vibrissa is defined as a distinct bristle on the vibrissal angle or in this region (Figs 1 & 2), although sometimes very small (Fig. 5). It is sometimes variably developed within a family, i.e. present or absent, hence the multiple exits in the following key. There is usually one, but occasionally there are two or three pairs of vibrissae in some families. The vibrissa is often medially incurved (i.e. orientation different to adjacent bristles) and is longer and/or stronger than supravibrissal and adjacent subvibrissal bristles. Sometimes it is the only bristle on the lower part of the head. The vibrissa is usually dark; clusters of hairs (i.e. apparently flexible vestiture) at the vibrissal angle (Coelopidae (Fig. 42)) are explicitly excluded from the definition of vibrissae. Periscelididae are treated as lacking vibrissae, although pseudovibrissae (anteriorly directed but *below* the vibrissal angle) are present in *Stenomicra* Coquillet (Fig. 7). Undescribed species of *Melanochthiphila* Frey (Chamaemyiidae) have the anterior cheek/subcranial bristle unusually vibrissa-like (Fig. 8); cheek and subcranial bristles in other chamaemyiid species are otherwise recognisable as such (Fig. 46). Agromyzidae are treated as always having distinct (albeit sometimes small) vibrissae; two aberrant Cape species of *Ophiomyia* Brazhnikov (*O. anomala* Spencer and *O. lunatica* Spencer) lack vibrissae.

Vibrissal angle. This is an important point of reference on the anteroventral part of the acalyptrate head, and denotes the position where the vibrissa is inserted. It is often protuberant and thus relatively conspicuous (Fig. 2). The vibrissal angle is positioned just lateral to the epistomal region, at the lower extent of the facial ridge.

KEY TO FAMILIES

[The Braulidae (2 species) and the sphaerocerid *Scutelliseta* Richards (18 species) are apterous and cannot be identified using this key. *Braula* species are minute mite-like insects (Fig. 18) found in honeybee hives. *Scutelliseta* is small and ant-like (Fig. 19), with the characteristically enlarged and shortened hind basal tarsomere of the Sphaeroceridae; it is collected in the leaf-litter of indigenous forest.]

1 One or occasionally two or three vibrissae positioned at or *very* near vibrissal angle (Figs 2, 3 & 5); if other bristles present on anterior part of cheek then vibrissa noticeably longer and/or stronger (Fig. 4), or with a different orientation (generally anteromedially incurved instead of ventrally or anteroventrally directed). [Note: Although Periscelididae (Fig. 7) have pseudovibrissae, true vibrissae are *absent*: proceed to couplet 30.] **2**

– No vibrissae differentiated at or near vibrissal angle (e.g. Fig. 45): either no bristles there or bristles all of similar length, strength and orientation (Fig. 6), or other cheek/subcranial bristles longer and stronger (e.g. Fig. 8) **30**

2 Subcostal spine(s) or setula(e) differentiated on costa, these often longer and stronger than adjacent vestiture (Figs 9, 56 & 57) [careful examination required]. Subcosta complete (not evanescent apically) (Fig. 56), if appearing complete then insertion and orientation of fronto-orbital bristles *not* as in Fig. 36. Postocellar bristles always present and convergent. Preapical tibial bristles present[1] **3**

– Without this combination of character states **5**

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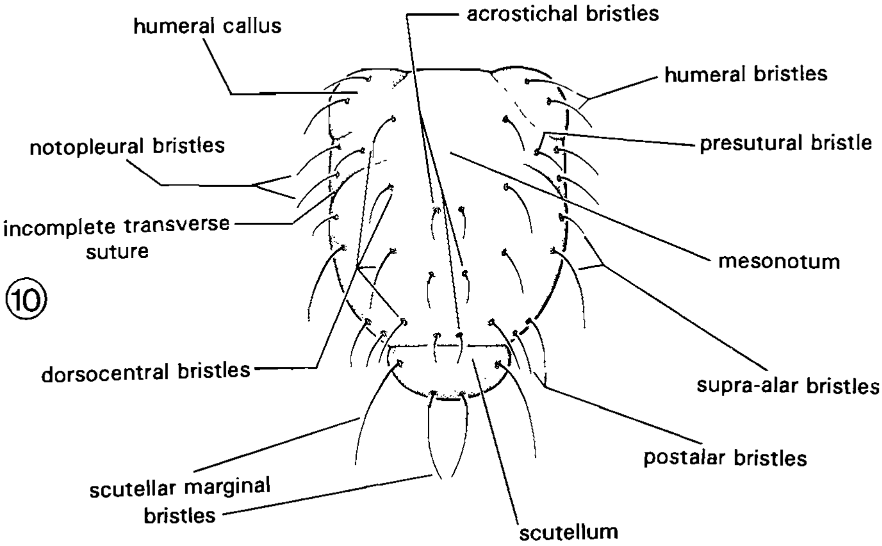
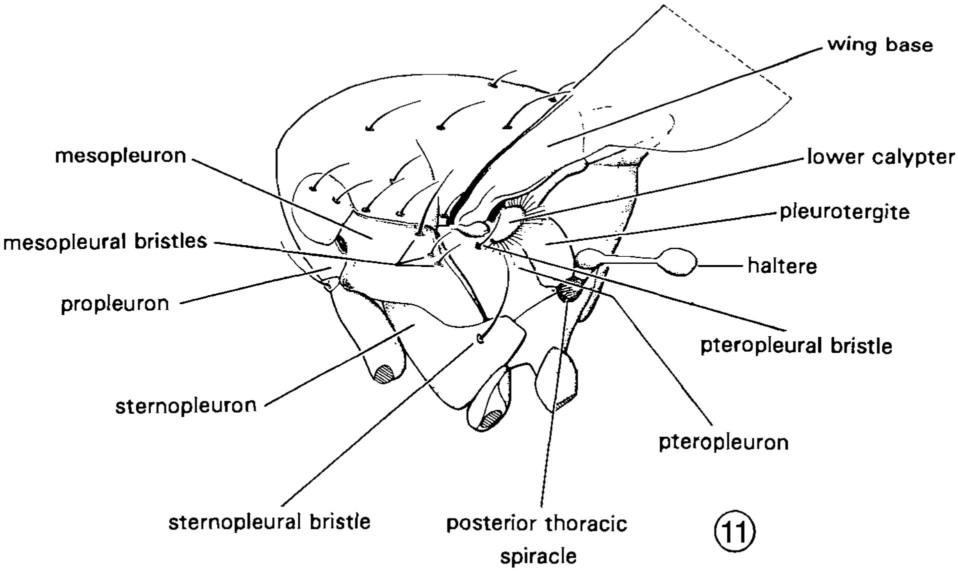
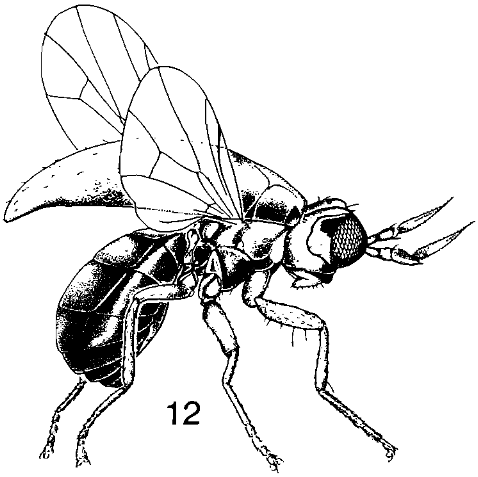
[1] *Tachiniscidia africana* Malloch, the only southern African species of Tachiniscidae (head as in Fig. 20 and veins R_1 and R_{4+5} strongly setulose), has the subcosta reaching just short of the costa and the mid and hind preapical tibial bristles difficult to discern (proceed to couplet 3).





Figs 10–11. Structure and terminology of acalyptrate thorax. 10. Dorsal view, showing distribution and position of bristles. 11. Lateral view, also showing wing base, lower calypter and coxae.



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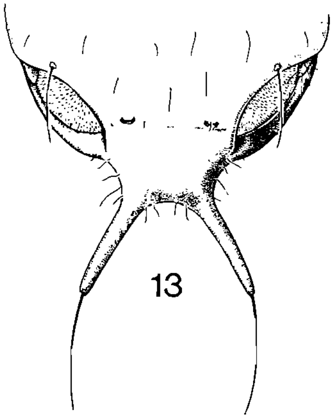

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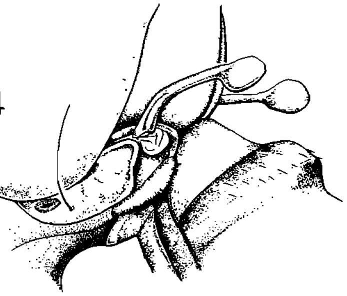

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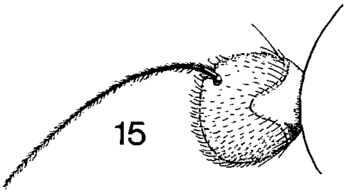

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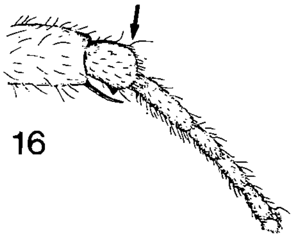

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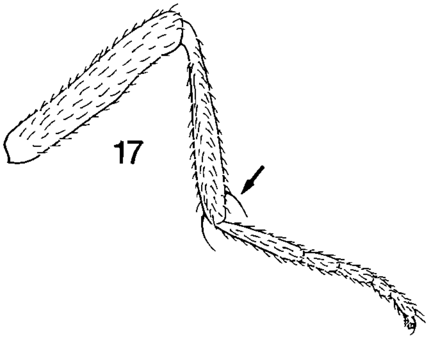
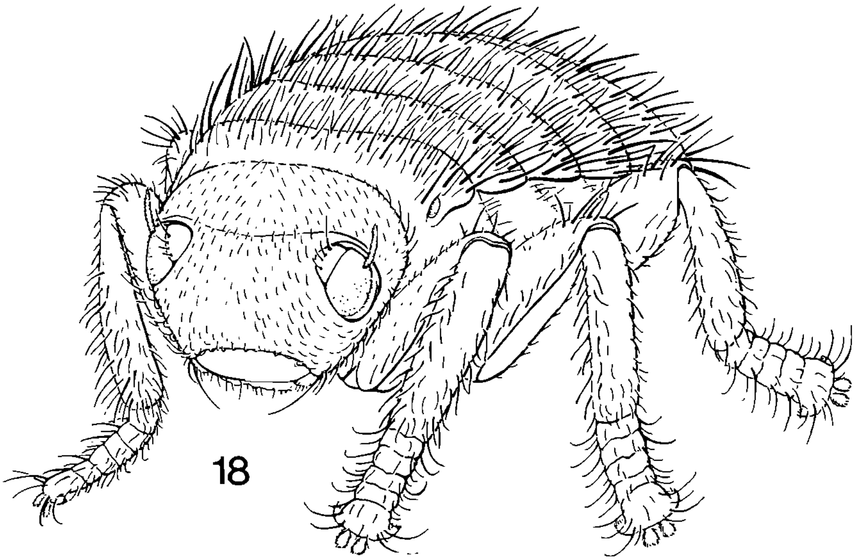
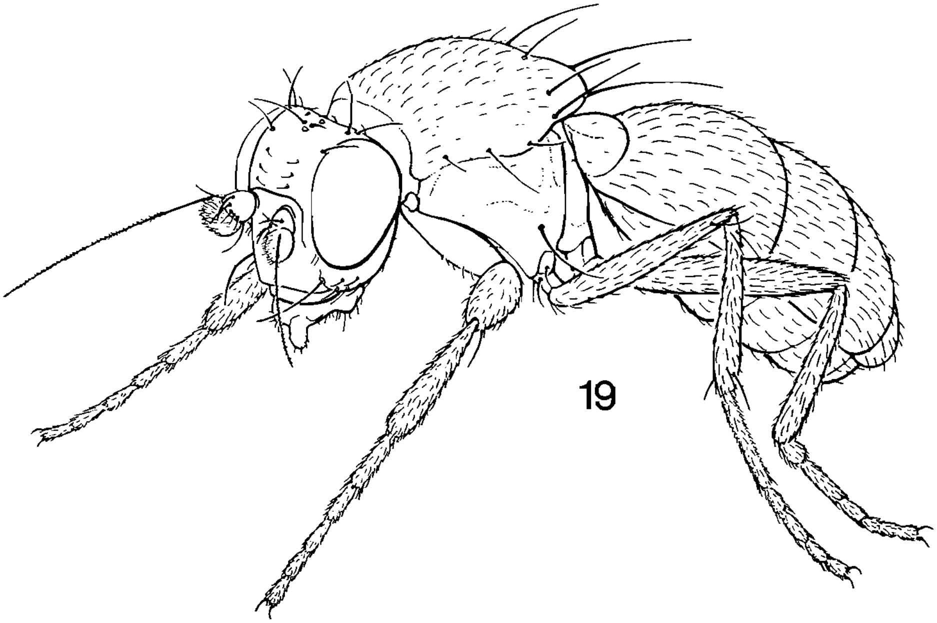


17

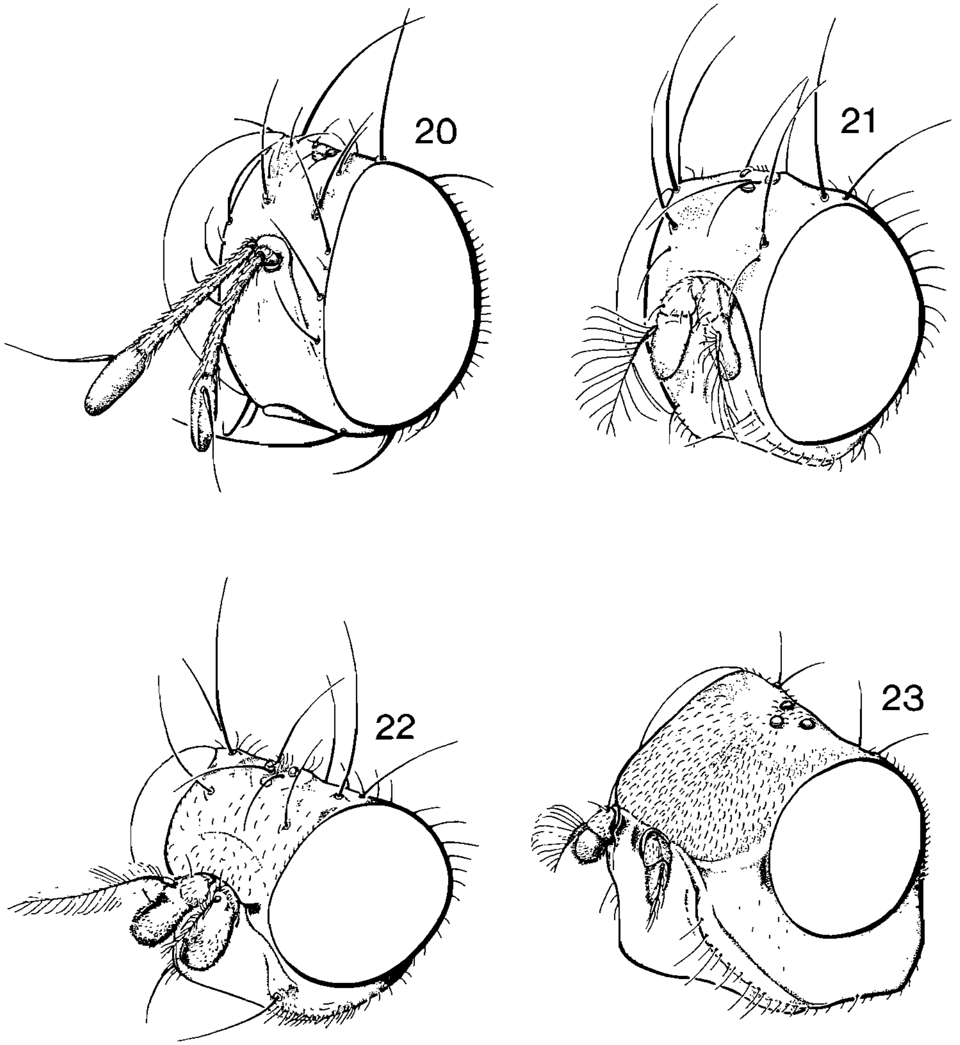
Figs 12–17. Miscellaneous characters of southern African acalyptrate families. 12. **Celyphidae** (*Spaniocelyphus umsinduzi* Stuckenberg), lateral habitus, showing massive development of elytra-like scutellum and porrect antennae with compressed, blade-like aristae. 13. **Diopsidae** (*Diasemopsis aethiopica* (Rondani)), dorsal view of scutellum, showing striking development of tubular, marginal prominences, each with apical bristle. 14. **Sepsidae** (*Paratoxopoda depilis* (Walker)), posterior section of thorax in lateral view, showing thin bristle near posteroventral margin of metathoracic spiracle. 15. **Clusiidae** (*Tetrameringia aethiopica* Stuckenberg), antenna in lateral view, showing triangular extension of second segment at mid-height of outer surface. 16. **Sphaeroceridae** (*Copromyza clunicrus* (Duda)), hind tarsus in lateral view, showing swollen and shortened basal tarsomere (arrowed). 17. Generalised acalyptrate mid leg in anterior view, showing (dorsal) preapical tibial bristle (arrowed) and mid tibial ventral spur.





Figs 18–19. Habitus illustrations of apterous southern African acalyptrate genera. 18. **Braulidae** (*Braula* sp.), a minute mite-like species found in honey-bee hives. 19. **Sphaeroceridae** (*Scutelliseta mischogaster* Norrbom), a small fly from the leaf litter of indigenous forest.

3 Four or more strong fronto-orbital and upper parafacial bristles (Fig. 20). Three pairs marginal scutellar bristles. Veins R_1 and R_{4+5} setulose along much of length. [Large flies. Bristles profuse and generally well developed. Second antennal segment elongate, about 3.0 X length of third segment (Fig. 20). Prosternum weakly setulose. Propleuron strongly setulose. Pteropleural bristles arise from small tubercle. Anal cell with prominent, acutely angled posterodistal projection.] .... **Tachiniscidae**

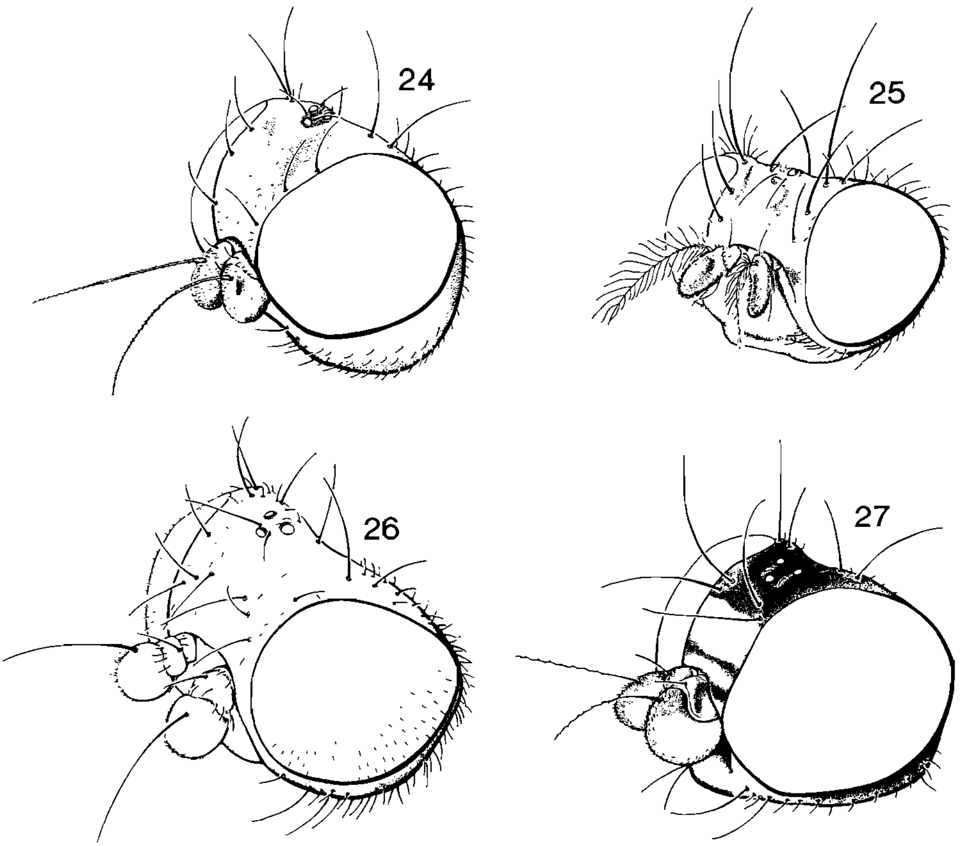


Figs 20–23. Heads of southern African acalyptrate families. 20. **Tachiniscidae** (*Tachiniscidia africana* Malloch), showing five pairs strong fronto-orbital/upper parafacial bristles and strikingly elongate second antennal segment. 21. **Curtonotidae** (*Curtonotum cuthbertsoni* Duda), showing two relatively strong pairs fronto-orbital bristles, one pair being proclinate. 22. **Heleomyzidae** (*Suillia picta* (Wiedemann)), showing only one pair fronto-orbital bristles, these reclinate. 23. **Ephydridae** (*Dryxo ornata* (Macquart)), showing general reduction in and lack of bristles, and presence of dorsal aristal vestiture only.

– At most two pairs strong fronto-orbital bristles. Two pairs marginal scutellar bristles. Veins R_1 and R_{4+5} without setulae **4**

4 Proclinate (one pair) fronto-orbital bristles nearly always present (Fig. 21). Two pairs dorsocentral bristles. Basal crossvein absent (Fig. 56). [Thorax generally bulbous and with prominently hump-backed appearance in profile; upper margins of head and abdomen positioned noticeably below that of thorax.] .... **Curtonotidae**

– Proclinate fronto-orbital bristles absent (Fig. 22). Three to five pairs dorsocentral



Figs 24–27. Heads of southern African acalyptrate families. 24. **Chyromyidae** (*Gymnochiromyia* sp.), showing three pairs fronto-orbital bristles (lower pair incurved and upper two pairs reclinate) and presence of ocellar bristles. 25. **Lauxaniidae** (*Homoneura cuthbertsoni* Curran), showing two pairs reclinate fronto-orbital bristles and third antennal segment about four times length of second segment. 26. **New Family** (Undescribed genus and species), showing four pairs fronto-orbital bristles (all with different orientations, including proclinate and reclinate/outcurved pairs), convergent postocellar bristles and rounded third antennal segment. 27. **Aulacigastridae** (*Aulacigaster africana* Barraclough), showing lack of ocellar bristles (minute setulae present), two pairs closely approximated fronto-orbital bristles (proclinate pair anterior and lateral to reclinate pair), arista with sinuous appearance, and pale transverse fascia on anterior part of frons.

bristles. Basal crossvein present. [Costa with subcostal break, humeral break absent.] .... **Heleomyzidae**

5 Presutural, mesopleural and sternopleural bristles nearly always absent or not differentiated, at most one humeral bristle (few exceptions). Costa typically with subcostal break or thinning/attenuation; no humeral break (Fig. 48). Subcosta usually barely visible (Fig. 48). Anal cell open; basal crossvein absent (Fig. 48). CuA_1 often with a flexure near mid-length of discal cell (Fig. 48). Preapical tibial bristles absent; hind tarsus with basal tarsomere typically not swollen or shortened relative to second tarsomere (e.g. Fig. 17). [Usually inhabit grass or low vegetation. Ocellar triangle typically on well defined, often glossy, large ocellar plate. Propleuron generally with sharp, vertical ridge on anterior section (not discernible if head closely applied to thorax.] .... **Chloropidae**

– Without this combination of character states **6**

6 Postocellar bristles absent or divergent and reduced. Aristal vestiture, if present, along dorsal surface only (Fig. 23). Costa with humeral break (rarely attenuation) and subcostal break (Fig. 49). Anal cell open; basal crossvein absent. Hind leg with basal tarsomere either not swollen (relative to apical tarsomeres) or longer than second tarsomere (Fig. 17). [Usually collected at margins of fresh or brackish water. Face often bulbous and protrudent (Fig. 23). Subcosta incomplete, usually merging with R_1 (Fig. 49). Preapical tibial bristles usually absent.] .... **Ephydridae**[2]

– Without this combination of character states **7**

7 Fronto-orbital bristles all noticeably outcurved (greatly reduced and pale in *Xanthocanace capensis* Wirth) and lower fronto-orbitals never incurved (Fig. 40). Face prominent and bulbous, conspicuous in profile (Fig. 40). Subcosta complete, although may appear weakly developed and closely approximated to R_1 apically (try viewing ventrally). [Inhabits seashores. Cheek usually with two upwardly directed bristles (Fig. 40). Mesofrons always with setulae or bristles (Fig. 40). Costa with subcostal break. Second basal and anal cells distinct. Preapical tibial bristles absent.] .... **Canacidae**

– Fronto-orbital bristles usually proclinate, reclinate or occasionally incurved, sometimes absent; if all apparently outcurved then face inconspicuous in profile or subcosta incomplete **8**

8 Three or more pairs fronto-orbital bristles (lower pairs rarely very weakly developed), lower two pairs never both outcurved. Postocellar bristles absent or convergent. Arista bare or virtually so. Humeral costal break absent. Subcosta complete, but often pale or thin and weak apically (Fig. 60), joining costa close to insertion of R_1 in Chyromyidae **9**

– Without this combination of character states **10**

9 Three or fewer fronto-orbital bristles (Fig. 24). One mesopleural bristle. One sternopleural bristle. Costa with subcostal break (Fig. 60) (often difficult to

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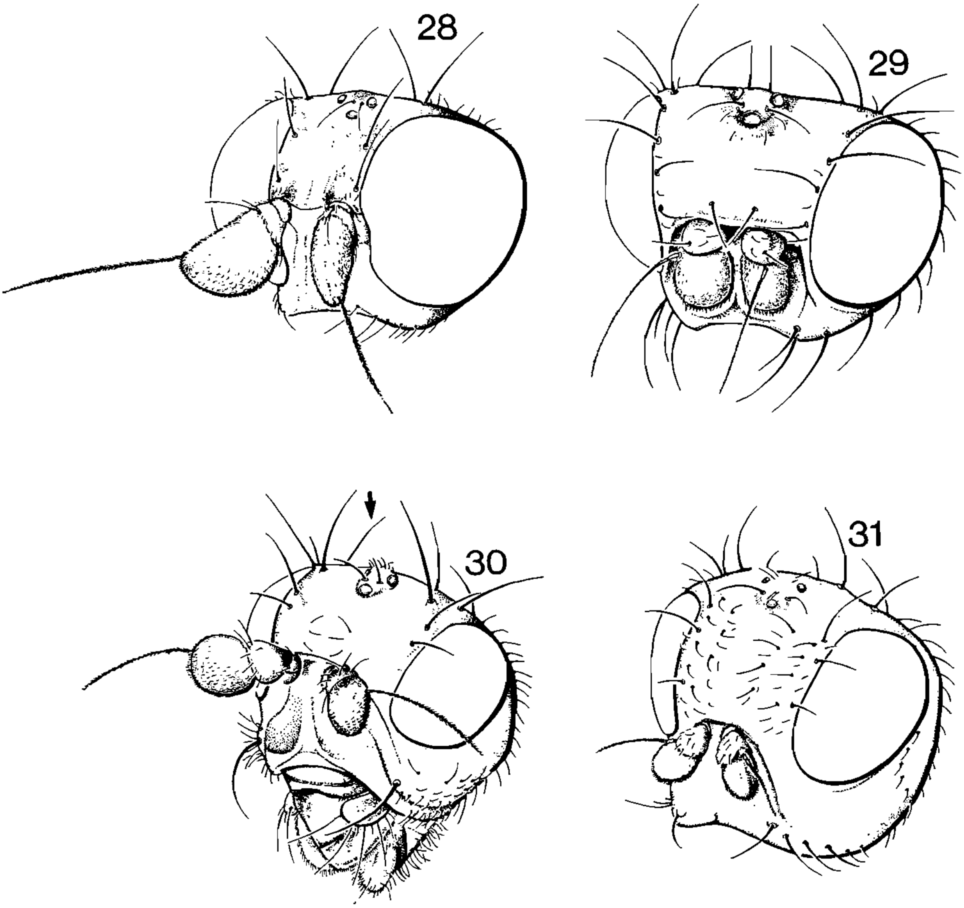
[2] *Carnus* Nitzsch (Carnidae), a minute avian parasite, is likely to be recorded from southern Africa, and should exit here. It is distinguished from Ephydridae by the lack of incurved lower fronto-orbital bristles.

discern). Preapical tibial bristles absent. [Fronto-orbital bristles incurved and/or reclinate (Fig. 24).] .... **Chyromyidae**

– Four fronto-orbital bristles, including cruciate pair adjacent to mesofrons (Fig. 26). Mesopleuron bare. Three or more sternopleural bristles. Costa without subcostal break. Preapical tibial bristles present. [Fronto-orbital bristles variably directed, including proclinate and outcurved pairs (Fig. 26).] .... **New Family**

10 Posterior thoracic spiracle with at least one thin bristle near posteroventral margin (Fig. 14). Palpi vestigial. [Coprophagous habit. Usually dark coloured



Figs 28–31. Heads of southern African acalyptrate families. 28. **Marginidae** (*Margo aperta* D. K. McAlpine), showing lack of postocellar bristles, two pairs reclinate fronto-orbital bristles and prominent elongate-ovate third antennal segment with subapical arista. 29. **Carnidae** (*Meoneura* sp.), showing parallel postocellar bristles, four pairs fronto-orbital bristles (lower two pairs incurved, upper two outcurved), cruciate interfrontal bristles near antennal base, antennae in deep grooves and two to three vibrissa-like bristles on vibrissal angle. 30. **Sphaeroceridae** (*Leptocera* (*Poecilosomella*) *angulata* (Thomson)), showing strongly developed paravertical bristle (arrowed), two outcurved fronto-orbital bristles (proclinates absent), rounded third antennal segment, prominent clypeus and robust, short proboscis. 31. **Tethinidae** (*Afrotethina femoralis* (Munari)), showing widely separated postocellar bristles, outcurved fronto-orbital bristles and numerous interfrontal bristles and setulae.

with ant-like appearance and abdomen constricted at base. Postocellar bristles divergent. Antennal grooves and facial carina usually conspicuous. Sternopleural bristles always absent. Subcosta complete. Costal breaks absent.] .... **Sepsidae**

– Posterior thoracic spiracle without conspicuous bristle near posteroventral margin. Palpi small (sometimes difficult to see in Sphaeroceridae) to well developed **11**

11 Mesopleuron with at least one *distinct* bristle **12**

– Mesopleuron bare or with hairs/setulae. [Setulae conspicuous in Diastatidae (thorax hump-backed, proclinate/incurved fronto-orbital bristle lateral and posterior to reclinate fronto-orbital (Fig. 36)) and Aulacigastridae (profrons and epistomal region each with silver pollinose transverse fascia on dark ground colour (Fig. 27)).] **19**

12 Postocellar bristles parallel, divergent or absent **13**

– Postocellar bristles convergent, albeit sometimes reduced and widely separated (Tethinidae (Fig. 31)) or even hair-like (Chyromyidae) **16**

13 Two pairs fronto-orbital bristles, both reclinate, never incurved (Fig. 28). Costal breaks absent. [Third antennal segment prominent in profile, elongate-ovate, arista inserted just short of apex (Fig. 28). Postocellar bristles absent (Fig. 28). Wing infuscated along margin of costa. Subcosta incomplete. Apical crossvein absent in African species.] .... **Marginidae**[3]

– Three to five pairs fronto-orbital bristles, some always incurved. Costa always with subcostal interruption or break, humeral break sometimes present **14**

14 Wing always partly or entirely infuscated, patterning often conspicuous. Second antennal segment with outer margin having triangular extension at mid-height (Fig. 15), this sometimes weakly developed, but then wing infuscation prominent. [Slender-bodied, thorax often appearing slightly depressed in profile and fore coxae relatively remote from mid and hind pairs. One sternopleural bristle. Subcosta complete and separate from R_1.] .... **Clusiidae**

– Wing nearly always completely hyaline, sometimes slightly darker tinged, never patterned. Second antennal segment without a noticeable triangular extension on outer margin **15**

15 Vibrissae generally weakly developed, always only one pair. Postocellar bristles divergent or absent. Costa without humeral break. [Proclinate fronto-orbital bristles always absent; one to three incurved pairs of lower fronto-orbitals. Preapical tibial bristles always absent.] .... **Agromyzidae**

- Vibrissae well developed, two to three vibrissa-like bristles differentiated at vibrissal angle (Fig. 29). Postocellar bristles parallel (Fig. 29). Costa with humeral break. [Four fronto-orbital bristles, lower two pairs incurved and upper two pairs outcurved (Fig. 29). Antennae positioned in deep antennal grooves. Wing with conspicuous costal setulae basad of subcostal break.] .... **Carnidae**

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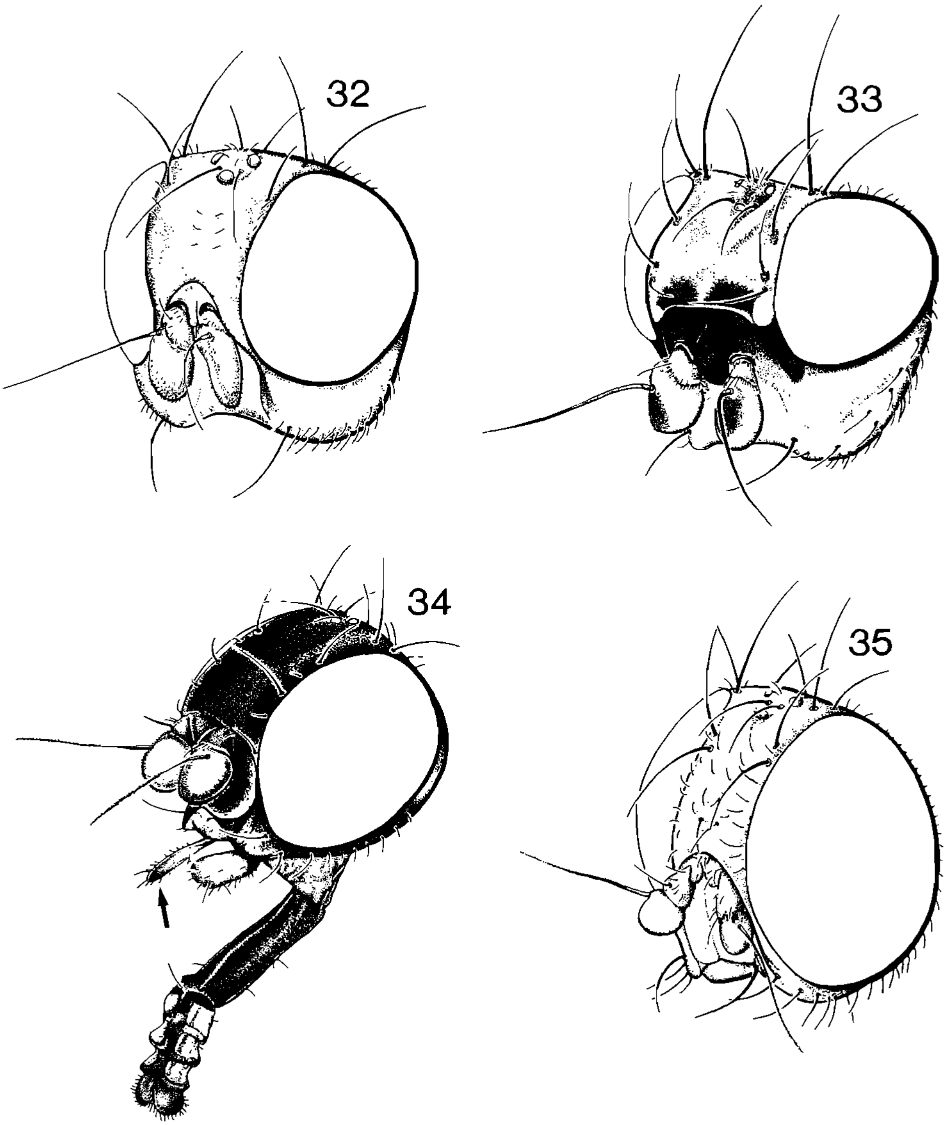
[3] (a) A rarely encountered species of *Clusioides* Coquillet (Clusiidae), although with a subcostal break, may exit here. It differs from Marginidae in having a pair of cruciate interfrontal bristles and the subcosta complete to the costal margin. (b) Some species of *Dasiops* Rondani and *Silba* Macquart (Lonchaeidae) may also appear to run to couplet 13. In such species, anterior cheek bristles, although distinctly below and posterior to the vibrissal angle, could be misinterpreted as vibrissae. All these lonchaeid species have only one pair of reclinate fronto-orbital bristles, these inserted near the anterior extremity of the ocellar triangle.



Figs 32–35. Heads of southern African acalyptrate families. 32. **Piophilidae** (*Piophila* (*Protopiophila*) *aethiopica* Hennig), showing divergent postocellar bristles and only one pair fronto-orbital bristles, these being reclinate. 33. **Odiniidae** (*Afrodinia* sp.), showing divergent postocellar bristles, three pairs fronto-orbital bristles (lower pair incurved, upper two pairs reclinate). 34. **Milichiidae** (*Litometopa glabrifrons* Sabrosky), showing three well-developed fronto-orbital bristles (lower two pairs incurved) and proboscis elbowed distally (maxillary palp arrowed). 35. **Milichiidae** (*Milichia* sp.), showing very large eye (filling virtually entire head profile) and interfrontal vestiture, including cruciate bristles near antennal bases.

16 Strongly outcurved fronto-orbital bristles present (Fig. 31). [Inhabit saline or brackish environments (seashores and adjacent coastal dunes). Mesofrons with conspicuous bristles or setulae along margins or over much of surface (Fig. 31). Arista without noticeable vestiture. Four pairs dorsocentral bristles. Anal cell closed.] .... **Tethinidae**

– Outcurved fronto-orbital bristles absent **17**

17 One pair dorsocentral bristles. Mesofrons with conspicuous pair of proclinate interfrontal bristles. [Minute species from arid regions.] .... **Chyromyidae**

Two or more pairs dorsocentral bristles, if only one apparent pair (cave dwelling species of Camillidae) then interfrontal bristles absent **18**

18 Costa without humeral break. Anal cell closed. [Ocellar bristles inserted outside ocellar triangle. Subcosta complete to margin, here very close to R_1, apical part thin.] .... **Heleomyzidae (Trixoscelidinae)**[4]

– Costa with humeral break. Anal cell open. [Usually one proclinate pair fronto-orbital bristles. Subcosta never complete to margin, obviously evanescent apically.] .... **Camillidae**

19 R_{2+3} reaching costa very close to R_1, within basal half of wing (as in Fig. 50). Second basal and discal cells confluent (Fig. 50). Anal cell absent. Costa without breaks. Ocellar bristles well developed. [Arista with sinuous appearance. Head often with pale fascia above epistomal margin. Costa strongly developed beyond juncture with R_1, and conspicuous setula usually visible near M_1 (Fig. 50). Apical crossvein and anal cell usually absent (Fig. 50).] .... **Asteiidae**

– Without this combination of character states **20**

20 Postocellar bristles (these not on ocellar triangle) divergent, well developed, eye never filling entire or virtually entire head profile (Figs 32 & 33) **21**

– Postocellar bristles convergent or parallel, sometimes absent, *if* well developed and moderately divergent then eye very large and filling virtually entire head profile (Milichiidae, as in Fig. 35) **22**

21 At most, one pair reclinate fronto-orbital bristles (Fig. 32). One pair dorsocentral bristles. Wing completely hyaline. [Thorax and abdomen metallic dark brown to black.] .... **Piophilidae**

– Three pairs fronto-orbital bristles, lower pair incurved (Fig. 33). Four to five pairs dorsocentral bristles. Wing with patterning. [Wing apex with longitudinal creases in membrane adjacent to R_{4+5}.] .... **Odiniidae**

22 Bristles on lower part of frons (fronto-orbital/interfrontal) incurved, usually strongly so (e.g. Fig. 34) *or* if absent/not incurved (Fig. 35) then costa with conspicuous notch at subcostal break (Fig. 51). Hind basal tarsomere typically

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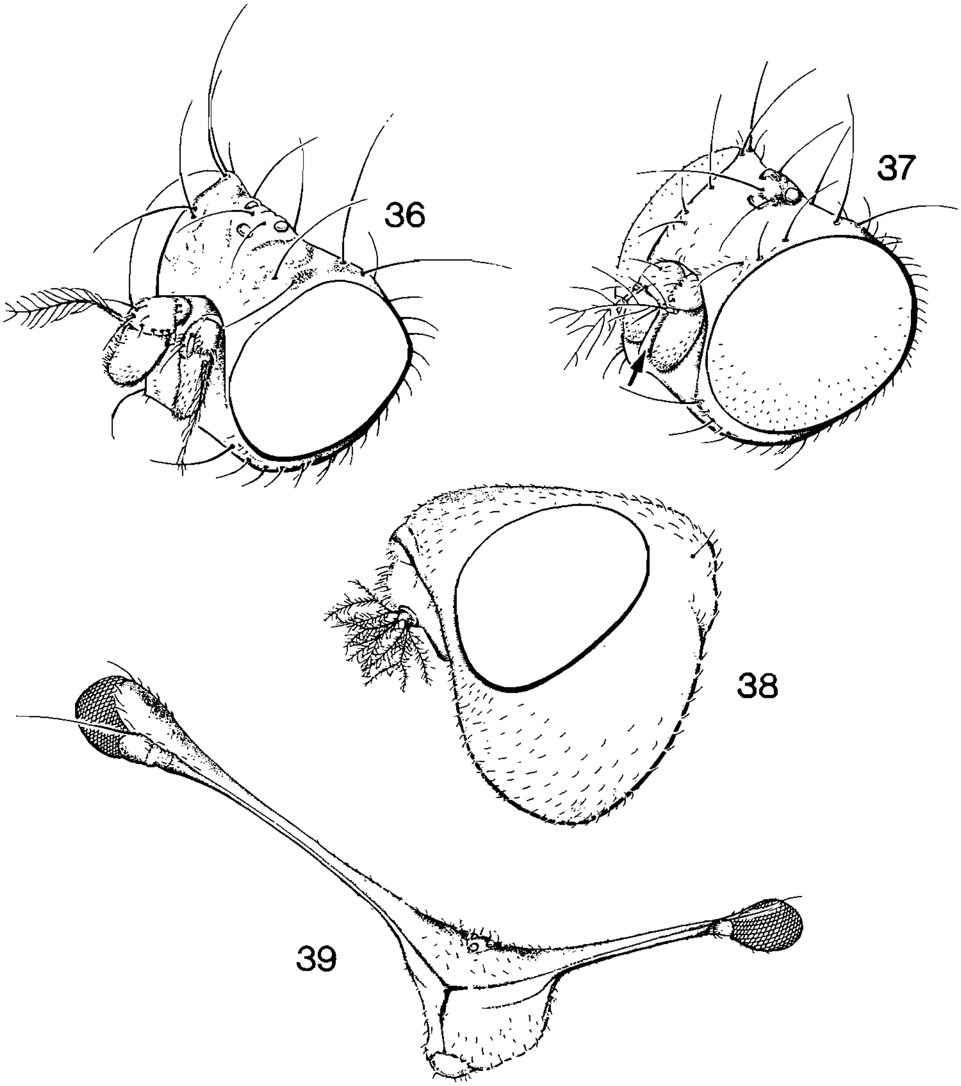
[4] (a) *Drepanephora* Loew (Lauxaniidae), with two southern African species, could exit here or near here. The genus is atypical of Lauxaniidae in having apparent vibrissae differentiated; it is immediately recognisable by a prominent, raised ocellar tubercle and certain head and thorax bristles being blade-shaped (Stuckenberg 1963: 3). (b) *Melanochthiphila* species (Chamaemyiidae) may also exit near here, although the anal cell is present. These undescribed species are mainly black (silver pollinose) with the characteristic chamaemyiid vein R_1 (abruptly approaches subcosta near bend of subcosta, but subsequently diverges away from the latter vein such that R_1 inserts on costa well beyond apex of subcosta (Fig. 62)).

longer and not swollen, relative to second tarsomere (Fig. 17) 23

– Bristles on lower part of frons, if present, not strongly incurved (if incurved then hind basal tarsomere shorter and/or swollen relative to second tarsomere (Fig. 16)); costa typically without conspicuous notch at costal break, if incurved bristles present 24



Figs 36–39. Heads of southern African acalyptrate families. 36. **Diastatidae** (*Diastata tsacasi* Cogan), showing well-developed ocellar bristles and two closely approximated pairs of fronto-orbital bristles (proclinate pair posterior and lateral to reclinate pair). 37. **Drosophilidae** (*Drosophila* (*D.*) *adamsi* Wheeler), showing three fronto-orbital bristles and long-plumose arista. 38. **Ctenostylidae** (*Ramuliseta lindneri* Keiser), showing characteristic head profile, great reduction and loss of bristles and dendritic arista of female. 39. **Diopsidae** (*Diasemopsis aethiopica* (Rondani)), showing laterally produced head with eyes (cross-hatched) and antennae borne on elongate stalks.

23 Scutellum with one pair marginal bristles. Costa without humeral break. [Prosternum with marginal hairs. One pair dorsocentral bristles. Scutellar bristles erect. Fore and hind femora greatly enlarged. Thorax strongly depressed.] .... **Neurochaetidae**

– Scutellum with two pairs marginal bristles. Costa with humeral break (Fig. 51). [Lunula often with pair of proclinate bristles. Mesofrons usually with setulae. Proboscis often geniculate (Fig. 34). Costa sometimes with conspicuous notch at subcostal break (Fig. 51).] .... **Milichiidae**

24 Proclinate fronto-orbital bristles either absent or weakly developed (e.g. Neminidae (Fig. 47)) **25**

– Proclinate fronto-orbital bristles always well developed (e.g. Fig. 36) **27**

25 Hind basal tarsomere markedly swollen (usually) and/or shorter than second tarsomere (Figs 16 & 19). Fronto-orbital bristles usually with some outcurved (Fig. 30). [Third antennal segment often rounded in profile (Fig. 30). Interfrontal vestiture usually apparent. Clypeus often prominent or enlarged and extending anteriorly below epistomal margin (Fig. 30). Proboscis relatively short and stout (Fig. 30).] .... **Sphaeroceridae**

– Hind basal tarsomere not swollen relative to more apical tarsomeres, always longer than second tarsomere. Fronto-orbital bristles, if present, usually reclinate or predominantly so **26**

26 R_{2+3} elongate and sinuous, inserted on costa relatively near wing-tip, within apical fifth of wing (Fig. 52). Wing partly or predominantly brown infuscated, sometimes conspicuously patterned (Fig. 52). [Ocellar bristles well developed. Eyes approximated below antennae. Two well-developed, reclinate fronto-orbital bristles.] .... **Anthomyzidae**[5]

– R_{2+3} short and relatively straight, inserted on costa at mid-length or within basal half of wing (Fig. 53). Wing mainly hyaline. [Ocellar bristles weakly developed (Fig. 47). Head and particularly thorax strongly depressed. Frons bristles weakly developed, cruciate interfrontal bristles present adjacent to ptilinal suture (Fig. 47). Second antennal segment with anterodorsal lobe on inner side (Fig. 47).] ...... **Neminidae**

27 Ocellar bristles absent, minute setulae just discernible (Fig. 27). Costa without humeral break. [Fronto-orbital bristles comprising one proclinate/incurved and one reclinate pair, closely positioned just anterior to ocellar triangle (Fig. 27). Frons with anterior half strikingly patterned: orange but darkened along anterior margin and here densely silver pollinose. Arista slightly sinuous (Fig. 27). Mesopleuron with short setulae along posterior margin.] .... **Aulacigastridae**

– Ocellar bristles obviously present (e.g. Fig. 37); sometimes absent in Drosphilidae (strikingly white to silver pollinose species), but then mesopleuron completely bare. Costa nearly always with humeral break, rarely with inconspicuous interruption **28**

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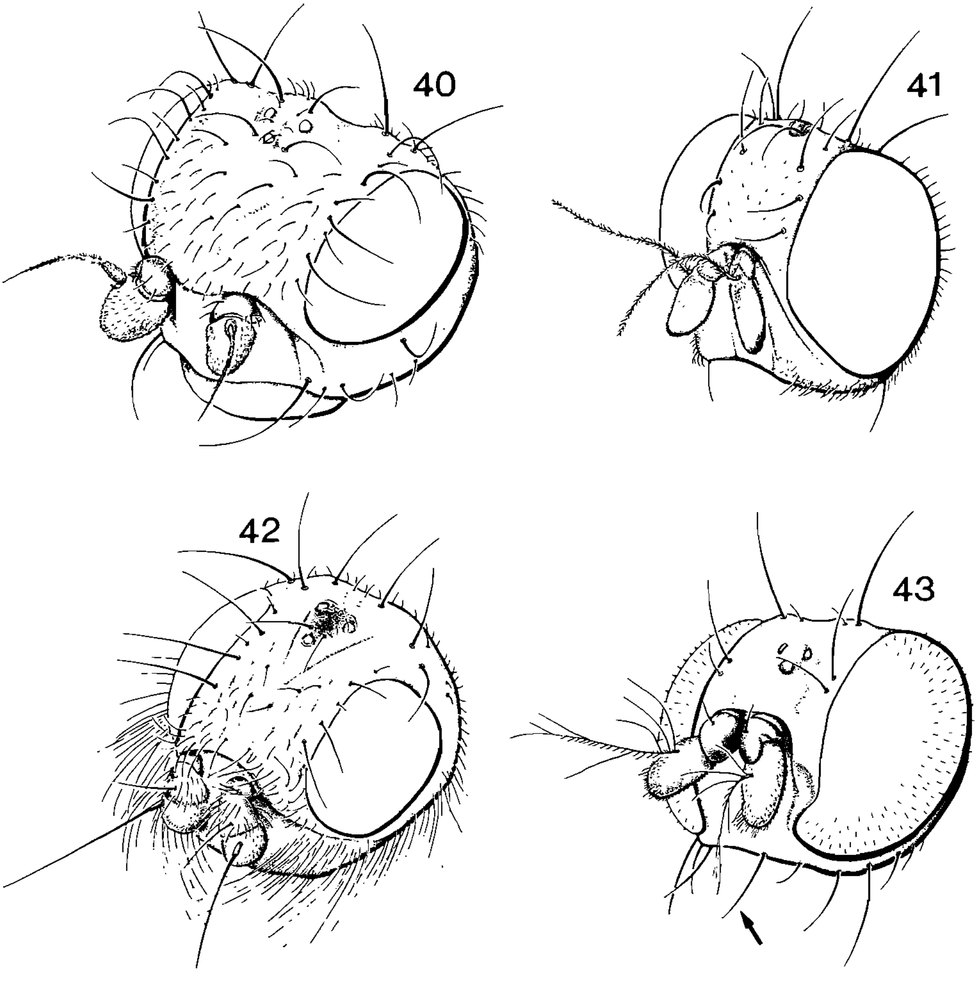
[5] A Namibian species of *Phlebosotera* Duda (Asteiidae) and allied taxa exit here. [Inner and outer vertical bristles weakly developed. Ocellar, fronto-orbital and interfrontal bristles all absent. Arista bare. Humeral and presutural bristles absent. One postsutural dorsocentral bristle, acrostichal bristles absent. Single sternopleural bristle, the only bristle on the pleuron. Tibial bristles absent. Second basal and discal cells confluent. Anal cell open.]

28 Mesopleuron setulose along posterior margin. [Two strong fronto-orbital bristles, reclinate bristle inserted anterior to proclinate bristle (Fig. 36). Thorax obviously hump-backed in profile. Costa with conspicuous setulae beyond subcostal break; two subcostal spines.] .... **Diastatidae**

– Mesopleuron completely bare **29**

29 Proclinate fronto-orbital bristle inserted between reclinate bristle and eye margin (similar to Fig. 36). Costa with humeral break not visible, although slightly



Figs 40–43. Heads of southern African acalyptrate families. 40. **Canacidae** (*Canace cala* Cresson), showing four strong pairs fronto-orbital bristles (all outcurved), mesofrons with numerous small bristles, face prominent and bulbous in profile and cheek with two upcurved bristles. 41. **Tephritidae** (*Pterandrus rosa* (Karsch)), showing four pairs fronto-orbital bristles (lower two pairs incurved, upper two reclinate). 42. **Coelopidae** (*Coelopa* sp.), showing three pairs outcurved fronto-orbital bristles, cluster of setulae on upper parafacial, conspicuous bristle near apex of second antennal segment and hirsute cheek and vibrissal angle region. 43. **Periscelididae** (*Stenomicra trimaculata* Sabrosky), showing lack of ocellar bristles, long-plumose arista, pseudovibrissa (arrowed) and strong, downcurved subcranial (and cheek) bristles.

attenuated near humeral vein (Fig. 54). [Restricted to montane forest above 1500 m. Dorsolateral regions of occiput with short, stubby spines. Thorax hump-backed in profile. Basal crossvein not visible.] .... **Campichoetidae**

– Proclinate fronto-orbital bristle never inserted between (anterior) reclinate bristle and eye margin, proclinate bristle typically anterior and medial to foremost reclinate bristle (Fig. 37). Costa with conspicuous humeral break (Fig. 55). [Widespread in many habitats. Typically three fronto-orbital bristles (Fig. 37). Arista often long-plumose (Fig. 37).] .... **Drosophilidae**

30 Ocelli absent. Proboscis either vestigial or short and stout (much shorter than head height)[6]. Wing usually patterned, never entirely dark brown to black, sometimes mainly hyaline. [Typically nocturnal, attracted to light sources.] **31**

– Ocelli nearly always present; if absent then proboscis either elongate (longer than head height) and slender *or* wing entirely dark brown to black. **32**

31 Proboscis not or barely visible, reduced to a minute vestige. Arista highly modified, branched and conspicuously plumose in female (Fig. 38). [Bristles reduced or absent. Thoracic pleura usually pink. Costa 'arched' basad of subcostal break. Anal cell apically truncate.] .... **Ctenostylidae**

– Proboscis short and stout (albeit sometimes small), always visible. Arista unmodified in both sexes, bare or short-pubescent. [Profrons often prominent. Facial carina nearly always present. Anal cell sometimes with posterodistal projection.] .... **Pyrgotidae**

32 Scutellum massively enlarged and elytra-like, produced backwards to cover virtually entire abdomen (Fig. 12); wings folded beneath scutellum in repose. [Antennae porrect, first segment elongate and slender, arista compressed and blade-like (Fig. 12). Head bristles greatly reduced. Thorax without bristles or setulae (Fig. 12).] .... **Celyphidae**

– Scutellum never greatly enlarged or elytra-like; wings never folded beneath scutellum in repose **33**

33 Arista absent. [Head and thoracic bristles greatly reduced. Third antennal segment greatly enlarged and pendulous. Wing broad, anal lobe pronounced. Second basal and discal cells confluent. Anal cell present, but imperfectly formed.] .... **Cryptochetidae**

– Arista present, albeit sometimes short (Fig. 44) or very reduced as in Conopidae, but then apically inserted on third antennal segment and antenna unusually elongate and porrect [rudimentary, but visible in *Lipochaeta* Coquillet (Ephydridae)] **34**

34 Scutellum with pair of striking, backwardly directed, tubular, marginal protuberances (Fig. 13); bristle sometimes inserted on apex of each protuberance (Fig. 13). Wing with second basal and discal cells confluent, anal cell closed. [Head often laterally produced such that eyes and antennae are borne on stalks (Fig. 39). Pleurotergite (in stalk-eyed species) modified to form spine-like protuberance. Fore femur typically swollen with double series of stout spines

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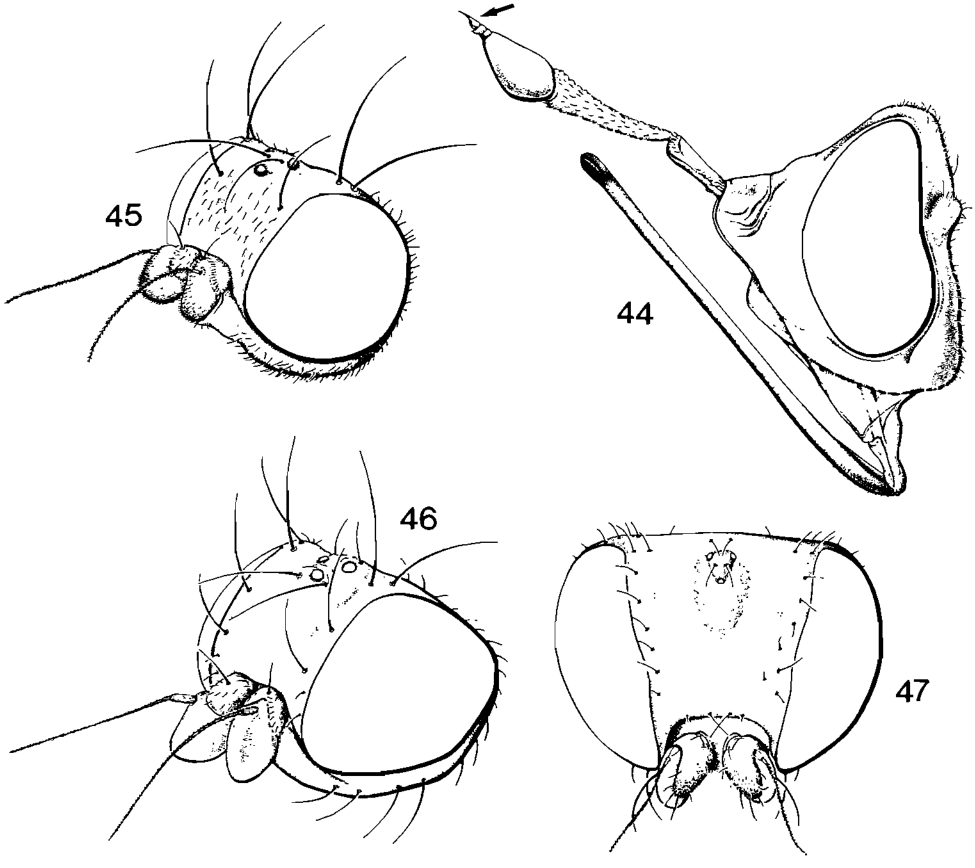
[6] Proboscis sometimes shorter than head height in some species of Conopidae without ocelli (antenna unusually elongate and porrect with short apical arista (Fig. 44)) [proceed to couplet 32].

along ventral surface. Wings short or markedly reduced in *Diopsina draconigena* Feijen.] .... **Diopsidae**

– Scutellum usually unmodified and without pair of backwardly directed marginal protuberances; if protuberances present then either second basal and discal cells not confluent or anal cell completely absent **35**

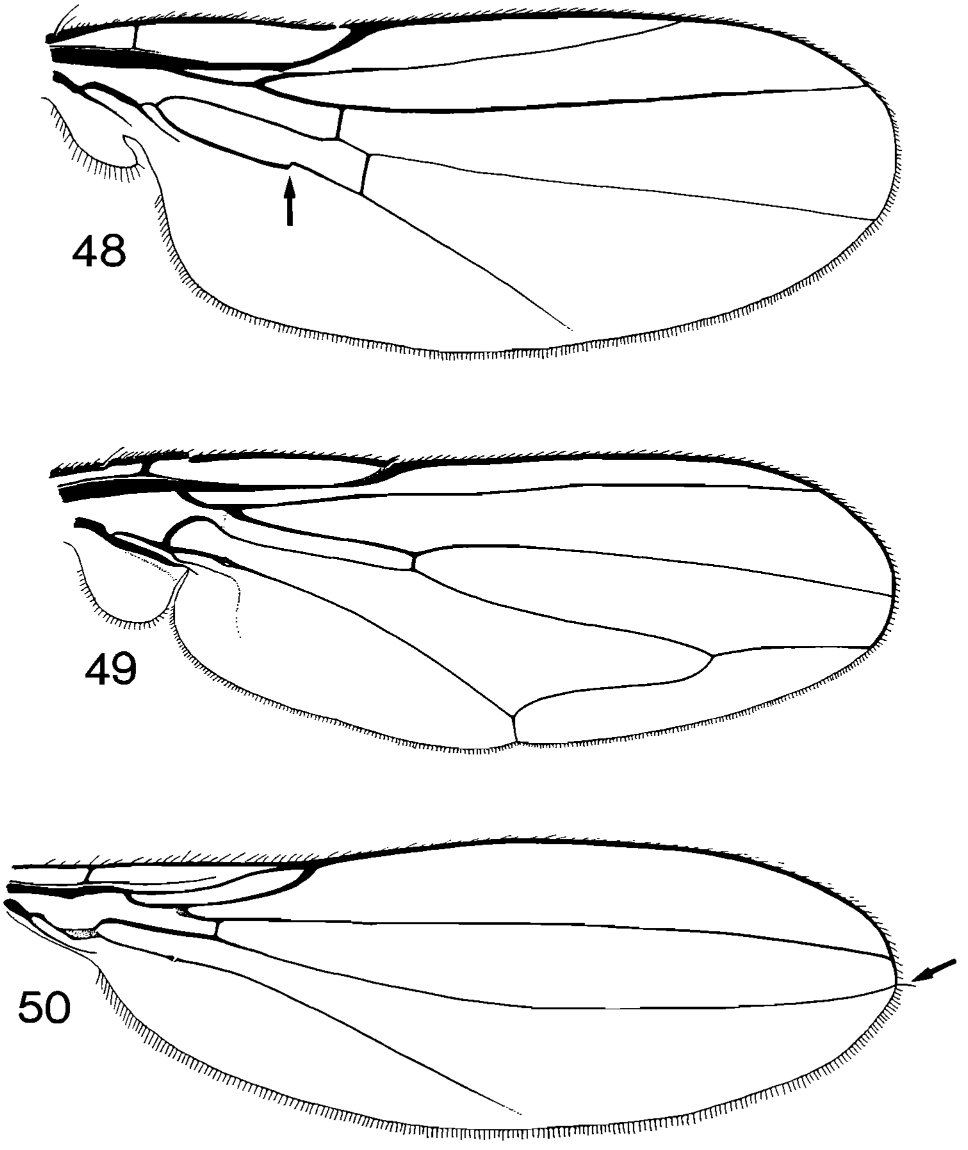
35 Postocellar bristles always present and convergent. One or more pairs reclinate fronto-orbital bristles (sometimes somewhat outcurved, but then complement and general orientation of fronto-orbital bristles as in Fig. 26). Presutural bristle present. Subcosta complete and obviously separate from R_1. Preapical tibial bristles present **36**

– Without this combination of character states **37**



Figs 44–47. Heads of southern African acalyptrate families. 44. **Conopidae** (*Conops* (*Asiconops*) *elegans* (Meigen)), showing loss of bristles, remarkably elongate and porrect antenna (arista arrowed) and elongate proboscis (prementum longer than head height). 45. **Opomyzidae** (*Opomyza capensis* Stuckenberg), showing lack of postocellar bristles, one pair well-developed and reclinate fronto-orbital bristles and rounded appearance of third antennal segment. 46. **Chamaemyiidae** (*Chamaemyia* sp.), showing convergent postocellar bristles, two pairs reclinate fronto-orbital bristles and unusually well-developed cheek bristles. 47. **Neminidae** (*Ningulus simatus* D. K. McAlpine), showing weakly developed ocellar bristles, about six pairs weakly developed fronto-orbital bristles (mostly not proclinate) and conspicuous anterodorsal lobe of second antennal segment.

36 One or (usually) two apparent pairs fronto-orbital bristles (Fig. 25). Mesopleural bristle(s) present. [Third antennal segment generally about 4.0 X length of second segment (Fig. 25). Wing often patterned.] .... **Lauxaniidae**



Figs 48–50. Wings of southern African acalyptrate families. 48. **Chloropidae** (*Elachiptereicus bistriatus* Becker), showing subcostal break only, weakly developed and barely visible subcosta, lack of basal crossvein, distinctive CuA_1 kink (arrowed) and open anal cell. 49. **Ephydridae** (*Dryxo ornata* (Macquart)), showing humeral and subcostal breaks, subcosta merged with R_1, lack of basal crossvein and anal cell open. 50. **Asteiidae** (*Asteia crassifacies* Sabrosky), showing lack of costal breaks, R_{2+3} joining costa very near R_1 in basal half of wing, costa noticeably thickened beyond R_1, conspicuous setula near apex of M_1, basal and apical crossveins absent, anal cell not apparent.

– Four pairs fronto-orbital bristles (Fig. 26). Mesopleural bristles absent. [Third antennal segment appearing rounded in profile (Fig. 26). Wing not patterned.] ..... **New Family**

37 Antenna with second and third segments in same plane, third segment being not pendulous (e.g. Fig. 23) *or* pseudovibrissae (Fig. 7) not present. Anal cell open; basal crossvein absent. Costa always, at least, with subcostal break or attenuation (sometimes difficult to discern in Chloropidae). Subcosta incomplete, either evanescent apically (Fig. 48) or merging with R_1 (Fig. 49) **38**

– Without this combination of character states **39**

38 Costa without humeral break (Fig. 48). Propleuron typically with sharp, vertical ridge on anterior section, although not discernible if head closely applied to thorax. [Often collected in grass or low vegetation. Ocellar triangle typically on large, well defined, often glossy, ocellar plate. Presutural, mesopleural and sternopleural bristles always absent or not differentiated. Preapical tibial bristles always absent.] .... **Chloropidae**

– Costa nearly always with humeral break (Fig. 49). Propleuron without vertical ridge on anterior section. [Usually collected at margins of fresh or brackish water. Face often bulbous and protrudent (Fig. 23). Postocellar bristles absent or divergent and reduced. Aristal vestiture, if present, along dorsal surface only (Fig. 23)..] .... **Ephydridae**

39 Vein R_1 with dorsal setulae on at least apical third to half its length (e.g. Figs 57 & 58), setulae occasionally absent apically, sometimes irregularly present in Schistopterinae (Tephritidae) with highly patterned wings but then setulae at least present at mid-length of R_1 (careful examination required)......................... **40**

– Vein R_1 bare or virtually so, sometimes with a few tiny setulae near base, or apically in *Milichia* Meigen (Milichiidae) but then eye fills almost entire head profile (Fig. 35) and costa prominently notched at subcostal break (Fig. 51) **42**

40 Fronto-orbital bristles with at least two (rarely one) of lower pairs incurved (Fig. 41)[7]. Subcosta typically turned sharply towards costa apically (Fig. 57), although often thinned or barely or not visible beyond bend. [Fronto-orbital bristles with upper pairs always reclinate (Fig. 41). Cheek nearly always with ventrally directed bristle below lower margin of eye (Fig. 41). Wing often patterned with stripes or spots. R_{4+5} often with dorsal setulae (Fig. 57).] .... **Tephritidae**

– Fronto-orbital bristles never incurved. Subcosta typically complete and not abruptly angular apically, sometimes apically absent or evanescent in Platystomatidae **41**

41 Anal cell with acutely angled posterodistal projection (Fig. 58) (inconspicuous in *Melieria* Robineau-Desvoidy, but then with apically pointed third antennal segment). R_1 with dorsal setulae along apical third to half only (Fig. 58); R_{4+5} never with dorsal setulae. [Postocellar bristles divergent. Sternopleuron with one bristle. Costa without obvious breaks.] .... **Otitidae (Otitinae)**

– Anal cell without posterodistal projection. R_1 with dorsal setulae along much of length; R_{4+5} often with dorsal setulae. [Postocellar bristles variously orientated, if present. Wing usually either dark infuscated or with some form of patterning.]..... **Platystomatidae**

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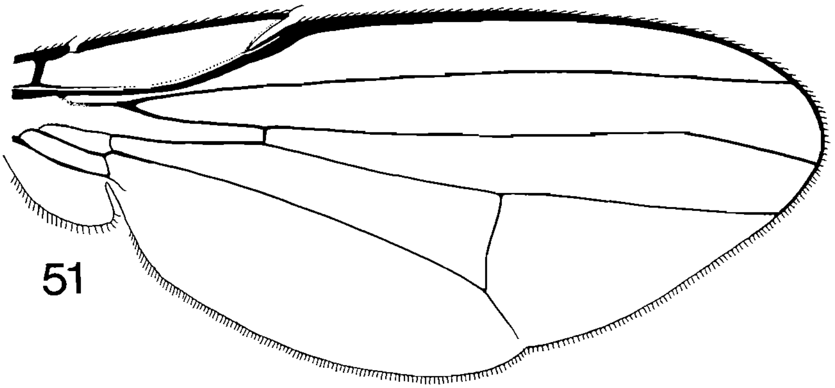
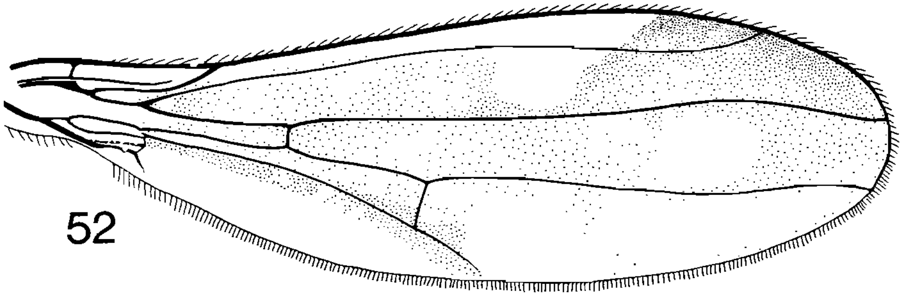
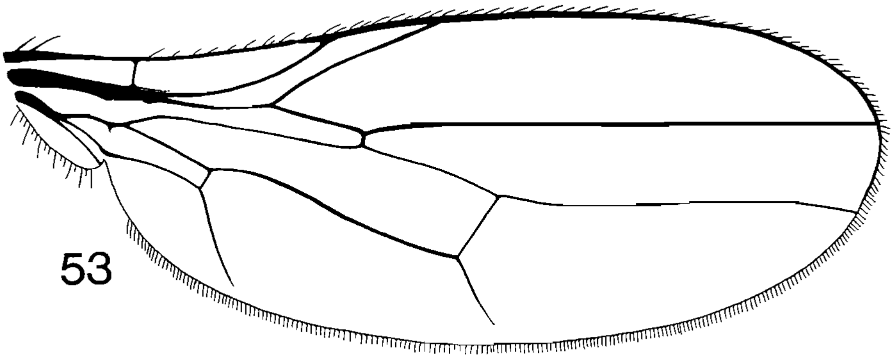
[7] Not apparent in *Hoplandromyia* Bezzi, but then with massive pair of erect and compressed fronto-orbitals, these about two-thirds eye height.







Figs 51–53. Wings of southern African acalyptrate families. 51. **Milichiidae** (*Milichia* sp.), showing humeral break and conspicuous costal notch at subcostal break. 52. **Anthomyzidae** (*Amygdalops* sp.), showing elongate and sinuous R_{2+3} inserted on costa in apical fifth of wing and conspicuous infuscation and patterning. 53. **Neminidae** (*Ningulatus simatus* D. K. McAlpine), showing short R_{2+3} inserted on costa at about mid-length of wing, much closer to R_1 than R_{4+5}.

42 Fronto-orbital bristles all (three pairs) conspicuously outcurved (Fig. 42). Parafacial with upper part bearing cluster of small bristles or setulae (Fig. 42). Second antennal segment with conspicuous apical bristle (Fig. 42). [Inhabits seashores. Vibrissal angle (and cheek) often with numerous elongate setulae (Fig. 42). Third antennal segment rounded (Fig. 42). Arista bare (Fig. 42). Thorax depressed. Legs usually densely covered with elongate, dark hairs/setulae.] .... **Coelopidae**

– Fronto-orbital bristles usually not outcurved or sometimes absent or barely visible, if all outcurved then upper parafacial bare and second antennal segment without conspicuous apical bristle **43**

43 Bristles on lower part of frons (fronto-orbital or interfrontal) always incurved, usually strongly so (Fig. 34); if absent (Milichiinae) then eye filling virtually entire head profile (Fig. 35) and costa prominently notched at subcostal break (Fig. 51). Mesopleuron without bristles. [Lunula often with pair of proclinate bristles. Mesofrons usually with setulae (Fig. 35). Proboscis often geniculate (Fig. 34).] .... **Milichiidae**[8]

– Bristles on lower part of frons, if present, nearly always not incurved; if incurved then mesopleuron with bristle(s) *or* (Neurochaetidae) thorax strongly depressed, cheek with prominent anteroventrally curved bristle and apical scutellar marginal bristles well developed and erect **44**

44 Pseudovibrissae (strong, anteroventrally directed bristles) present just below vibrissal angle (Fig. 7). Anal cell open. [Arista long-plumose (Fig. 43). Ocellar bristles absent (Fig. 43). Subcranial margin (and cheek) with series of strong (usually), downwardly directed bristles (Fig. 43). Basal crossvein not or weakly developed.] .... **Periscelididae**

– Without this combination of character states **45**

45 Posterior thoracic spiracle with at least one thin bristle near posteroventral margin (Fig. 14). Palpi vestigial. [Usually dark coloured with ant-like appearance and abdomen constricted at base. Postocellar bristles divergent. Antennal grooves and facial carina usually conspicuous. Sternopleural bristles always absent. Subcosta complete. Costal breaks absent.] .... **Sepsidae**

– Posterior thoracic spiracle without noticeable bristle near posteroventral margin. Palpi nearly always obviously present **46**

46 Fronto-orbital bristles present, at least three pairs, all prominently outcurved (Fig. 40) (greatly reduced in *Xanthocanace capensis* Wirth, but then all other bristles reduced and pale). [Inhabits seashores. Costa with subcostal break. Subcosta complete.] .... **Canacidae**

– Fronto-orbital bristles, if present, never all outcurved. Usually not inhabiting seashores **47**

47 Fronto-orbital bristles absent (Fig. 44). Proboscis elongate, often longer than head height (Fig. 44). [Antennae usually elongate and prominent in profile

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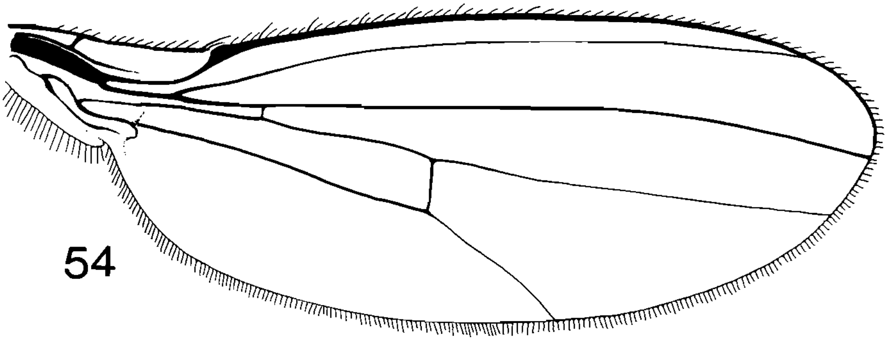
[8] Two species of *Ophiomyia* Brazhnikov (Agromyzidae), which are aberrant in lacking vibrissae, should exit here. These species are readily distinguished from Milichiidae by the presence of divergent postocellar bristles and a mesopleural bristle, and the lack of a humeral costal break.

(Fig. 44). Arista short and stout (Fig. 44). Proboscis often geniculate. Ocelli often absent. Subcosta, R_1 and R_{2+3} closely aligned to costa (Fig. 59). Cell r_{4+5} closed or narrowly open (Fig. 59). Anal cell usually with acutely angled posterodistal projection (Fig. 59).] .... **Conopidae**



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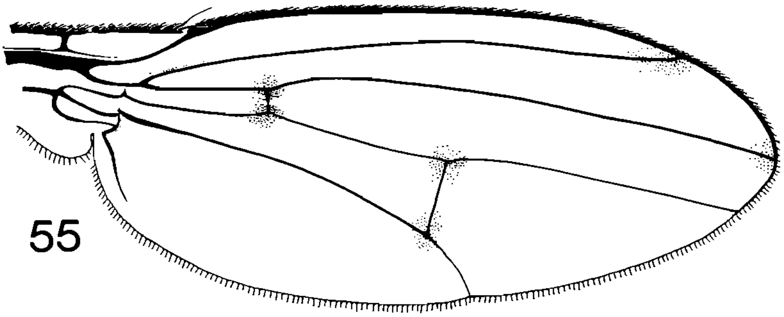

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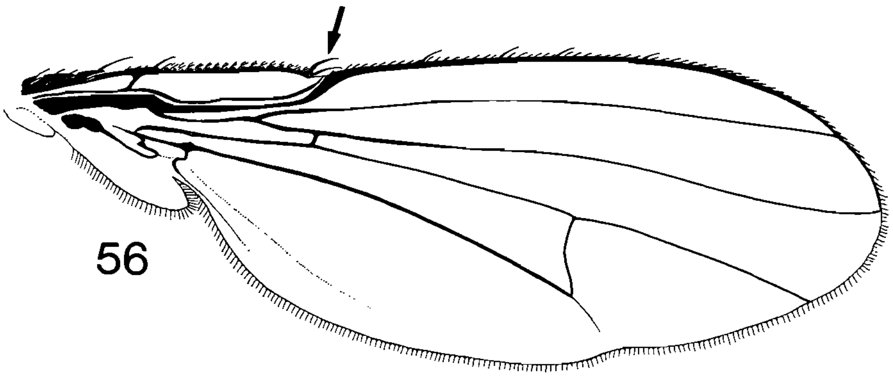

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Figs 54–56. Wings of southern African acalyptrate families. 54. **Campichoetidae** (*Campichoeta natalensis* Barraclough), showing lack of complete humeral break. 55. **Drosophilidae** (*Drosophila* (*Drosophila*) *adamsi* Wheeler), showing complete humeral break. 56. **Curtonotidae** (*Curtonotum cuthbertsoni* Duda), showing subcostal spines/setulae at subcostal break (arrowed), subcosta complete to costal margin and basal crossvein absent.

– Fronto-orbital bristles usually present, if absent then proboscis short and stout (shorter than head height) **48**

48 Postocellar bristles parallel or divergent. Mesopleural bristles absent. Preapical tibial bristles present. [Antennae porrect. Costa not broken. Subcosta complete and separate from R_1. Mid femur typically with conspicuous anterodorsal bristle. Mid tibia with ventral spur.] .... **Sciomyzidae**

– Without this combination of character states **49**

49 Sternopleuron without bristle(s) or vertical fan of hairs **50**

– Sternopleuron with one or more bristles (sometimes small) or vertical fan of hairs **51**

50 Second antennal segment with inner surface produced into finger-like projection along third segment. Arista apically positioned on third antennal segment. Postocellar bristles always convergent. Four pairs dorsocentral bristles. [Fore coxae anteriorly displaced from mid and hind pairs. Hind tibia with noticeable preapical bristle. Costa thinned or inconspicuously broken at subcosta, transverse hyaline strip not visible at anterior extent of subcosta.] .... **Neriidae**

– Second antennal segment unmodified, not with inner surface apically produced into a finger-like lobe. Arista dorsobasally positioned on third antennal segment. Postocellar bristles divergent or absent. At most, one pair dorsocentral bristles. [Subcranial bristles absent. Costa with subcostal break well before R_1, this continuous with a transverse hyaline strip (sometimes inconspicuous) in the membrane, severing end of subcosta and reaching to or beyond R_1 (Fig. 61). Preapical tibial bristles absent.] .... **Psilidae**[9]

51 Humeral callus always without bristle. Legs unusually elongate and slender. Preapical tibial bristles and mid tibial ventral spur absent. [Sternopleuron nearly always with vertical fan of hairs. At most, one pair dorsocentral bristles. Fore coxae anteriorly displaced from mid and hind pairs. Fore tarsus nearly always white, contrasted with remainder of leg. Costa always without breaks.] .... **Micropezidae**

– Humeral callus always with at least one bristle. Legs never unusually elongate. Preapical tibial bristles or mid tibial ventral spur usually developed **52**

52 Anal cell with prominent, acutely angled, posterodistal projection (e.g. Fig. 58). [Head with bristles reduced or virtually absent, at most two pairs fronto-orbitals. Postocellar bristles divergent or absent. Wing completely hyaline. Cell r_{4+5} apically narrowed or petiolate.] .... **Otitidae (Ulidiinae)**

– Anal cell without posterodistal projection **53**

53 One pair well-developed reclinate fronto-orbital bristles (Fig. 45). Four pairs dorsocentral bristles. Subcosta incomplete, at most extending about halfway between humeral crossvein and R_1. [Third antennal segment appearing rounded in profile (Fig. 45). Prosternum setulose.] .... **Opomyzidae**

– Without this combination of character states **54**

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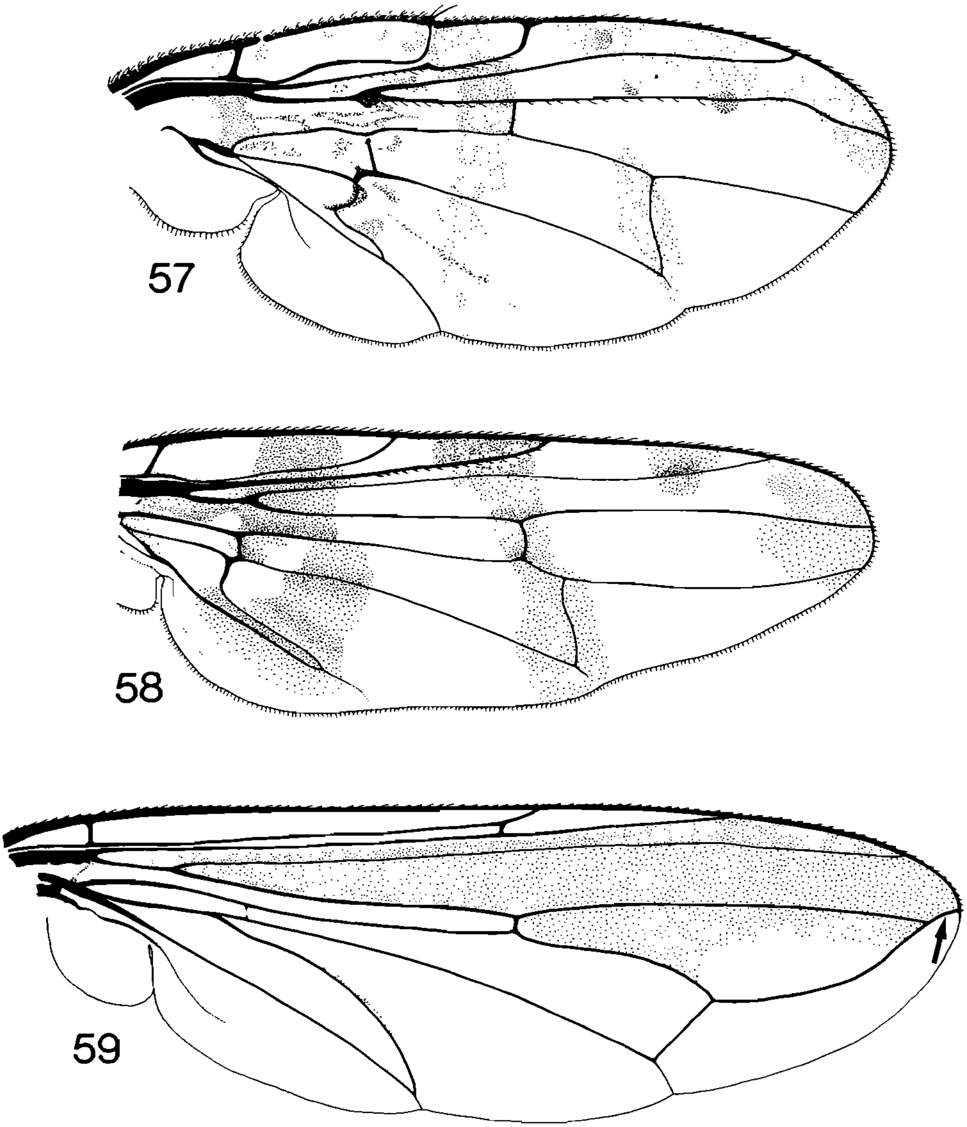
[9] *Sepedonella* Verbeke (Sciomyzidae) exits here; it is distinguished by having weak preapical tibial bristles, no costal breaks and one outcurved upper fronto-orbital bristle.



Figs 57–59. Wings of southern African acalyptrate families. 57. **Tephritidae** (*Pterandrus rosa* (Karsch)), showing subcosta turned sharply towards costa apically, subcostal setulae/spines differentiated; R_{2+3} and R_{4+5} with dorsal setulae, anal cell with acute posterodistal projection and wing patterned. 58. **Otitidae (Otitinae)** (Undescribed genus), showing lack of obvious costal breaks, setulae along apical half of R_1, and acutely angled posterodistal projection of anal cell. 59. **Conopidae** (*Conops* (*Asiconops*) *elegans* (Meigen)), showing subcosta, R_1 and R_{2+3} closely aligned with costa, cell r_{4+5} closed and petiolate (arrowed) and anal cell forming prominent, acutely angled posterodistal projection.

54 Postocellar bristles divergent, albeit reduced. Mesopleuron with two or more bristles. Haltere entirely dark (parts of stem sometimes excepted). [Coloration usually metallic dark brown, black, blue-black or green. One pair reclinate fronto-orbital bristles, inserted near anterior extremity of ocellar triangle. Wing

with anal lobe well developed.] .... **Lonchaeidae**

– Postocellar bristles convergent, parallel or absent. Mesopleuron, at most, with one bristle (small serial bristles or setulae in Aulacigastridae, but then with two fronto-orbitals). Haltere always pale (cream, yellow or pale brown) **55**

55 R_1 abruptly approaches subcosta near bend of subcosta, but subsequently diverges away from that vein such that R_1 inserts on costa well beyond apex of subcosta (Fig. 62). Fronto-orbital bristles either absent or reclinate (one or two pairs). [Appearance usually densely pollinose and colour silvery grey to brown. Cheek/subcranial bristle(s) present, anterior pair sometimes vibrissa-like (Fig. 8). Postocellar bristles usually present and convergent.] .... **Chamaemyiidae**

- R_1 without unusual curvature, not abruptly approaching subcosta and then diverging away from it; R_1 appearing swollen and slightly flexed towards bend of subcosta in Aulacigastridae, but then always with one pair proclinate/incurved fronto-orbital bristles **56**

56 Scutellum with one pair marginal bristles. Prosternum with marginal hairs. Sternopleuron with two bristles. [Cheek with prominent, anteroventrally directed bristle. Thorax strongly depressed. One pair dorsocentral bristles. Scutellar bristles erect. Fore and hind femora greatly enlarged.] .... **Neurochaetidae**

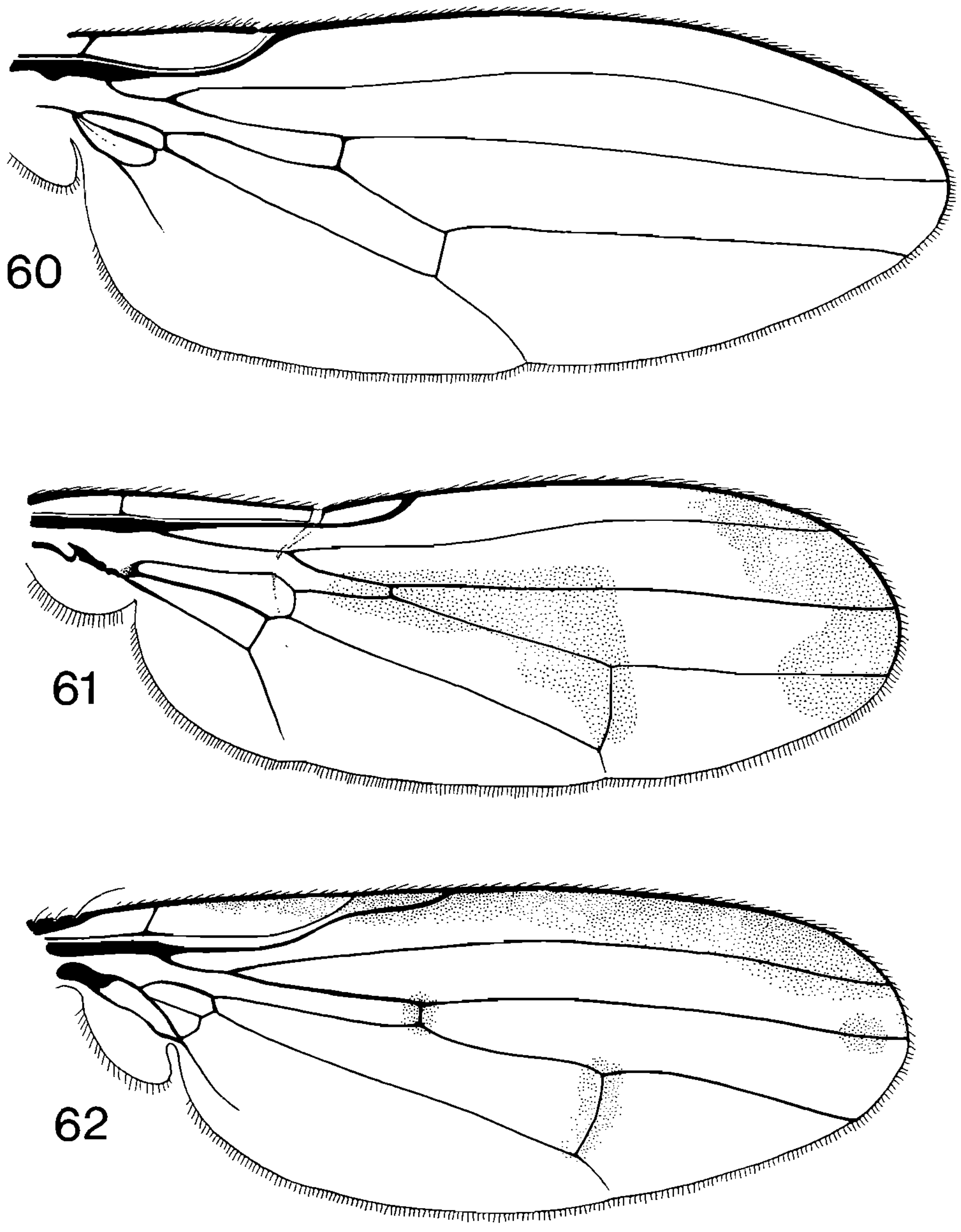
– Scutellum with two or more pairs of bristles or setulae. Prosternum without any vestiture. Sternopleuron, at most, with one bristle **57**

57 Second antennal segment with anterodorsal lobe on inner side (Fig. 47). Head and thorax markedly depressed in profile. Mesopleuron without any vestiture, including setulae. Marginal scutellar bristles erect and untapered. R_{2+3} inserted much closer to R_1 on costal margin than to R_{4+5} (Fig. 53). [Very small species. About six pairs, short and irregularly inclined/positioned, fronto-orbital bristles or setulae, cruciate interfrontal bristles present adjacent to ptilinal suture (Fig. 47).] .... **Neminidae**

– Second antennal segment without conspicuous anterodorsal lobe on inner side. Head and thorax not usually depressed in profile. Mesopleuron with setulae and/or bristle. Marginal scutellar bristles backwardly directed and noticeably tapered. R_{2+3} inserted much closer to R_{4+5} on costal margin than to R_1 (e.g. Fig. 60) **58**

58 Two pairs fronto-orbital bristles, closely approximated, lower pair proclinate/incurved and lateral to upper reclinate pair (Fig. 27). Ocellar bristles absent, minute setulae just discernible (Fig. 27). Mesopleuron with short setulae along posterior margin. Basal crossvein absent. [Anterior half of frons strikingly patterned: orange but darkened along anterior margin and here overlaid with dense silver pollinosity (Fig. 27). Arista slightly sinuous (Fig. 27). Presutural bristle absent.] .... **Aulacigastridae**

– Two or three pairs equally spaced fronto-orbital bristles, reclinate except lower pair incurved (Fig. 24). Ocellar bristles present (Fig. 24). Mesopleuron always with bristle differentiated on posterior margin. Basal crossvein present (Fig. 60). [Ground colour usually pale (yellow-brown), typically various shades of yellow.] **Chyromyidae**



Figs 60–62. Wings of southern African acalyptrate families. 60. **Chyromyidae** (*Gymnochiromyia* sp.), showing subcostal break, apically thin subcosta and presence of basal crossvein. 61. **Psilidae** (*Chyliza* sp.), showing costa with broad subcostal break well before R_1, this continuous with a transverse hyaline strip in the membrane, severing end of subcosta and reaching to and beyond R_1. 62. **Chamaemyiidae** (*Chamaemyia* sp.), showing R_1 abruptly approaching subcosta near bend of subcosta, but subsequently diverging away from that vein such that R_1 inserts on costa well beyond apex of subcosta.

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